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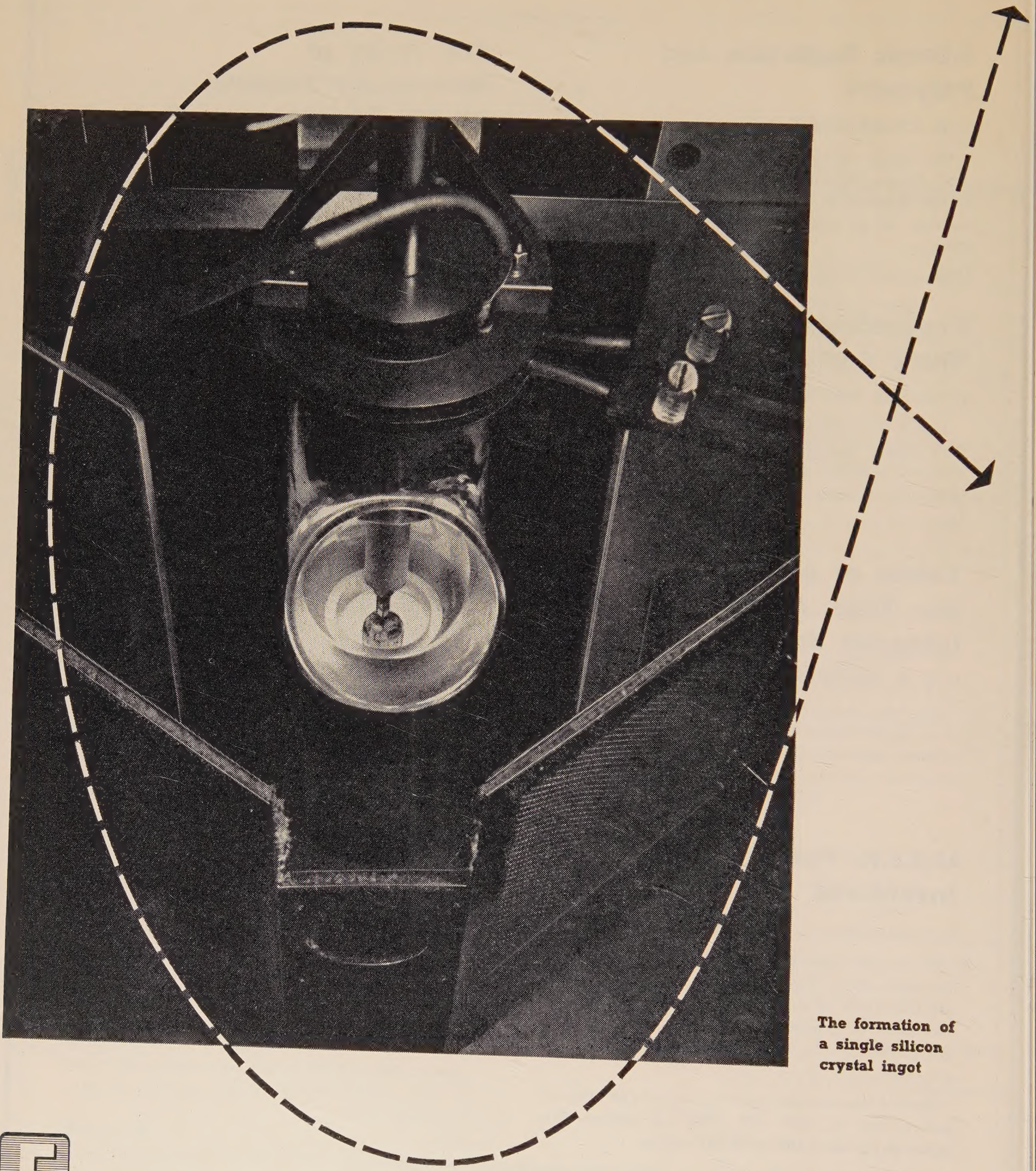

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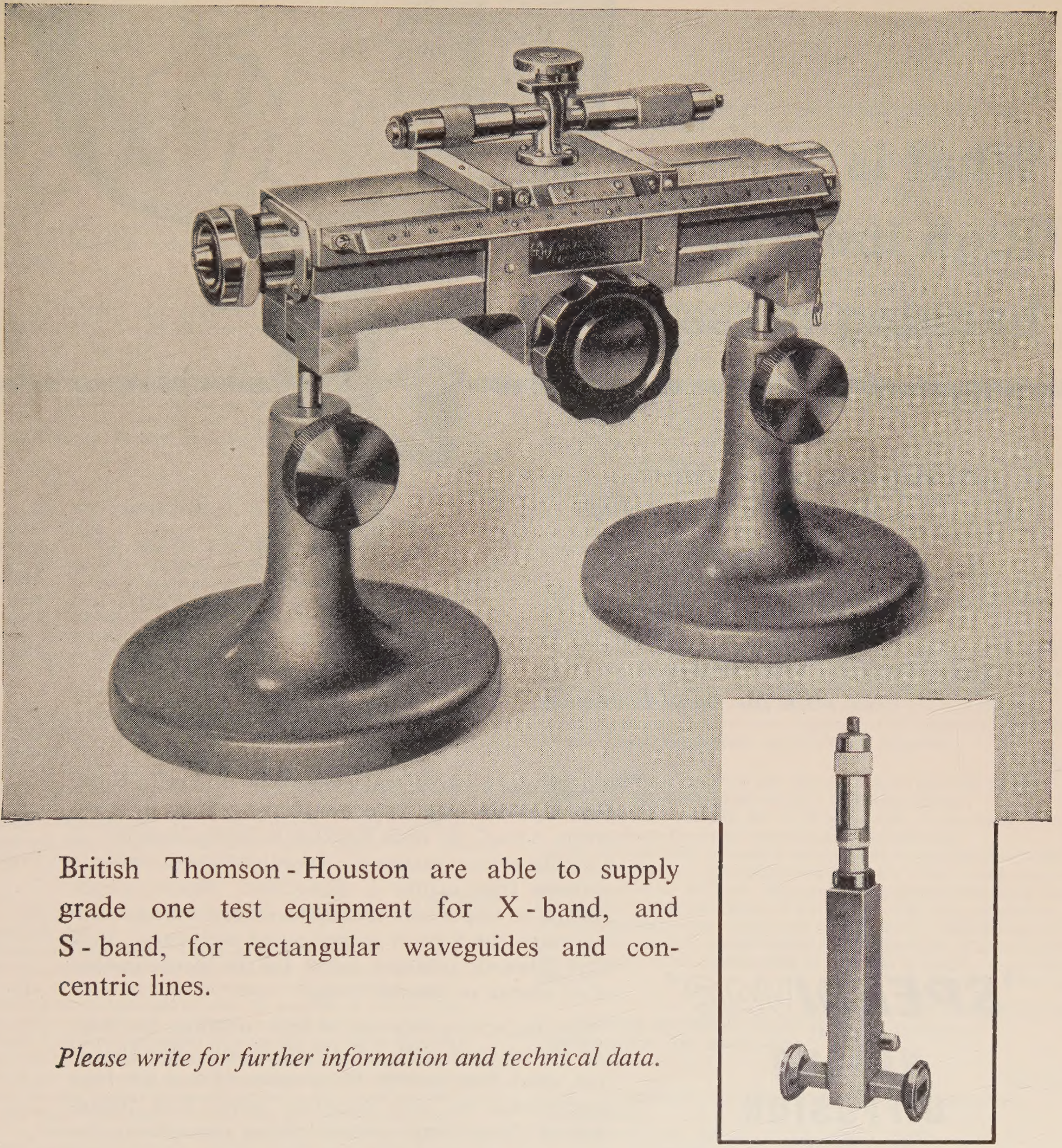

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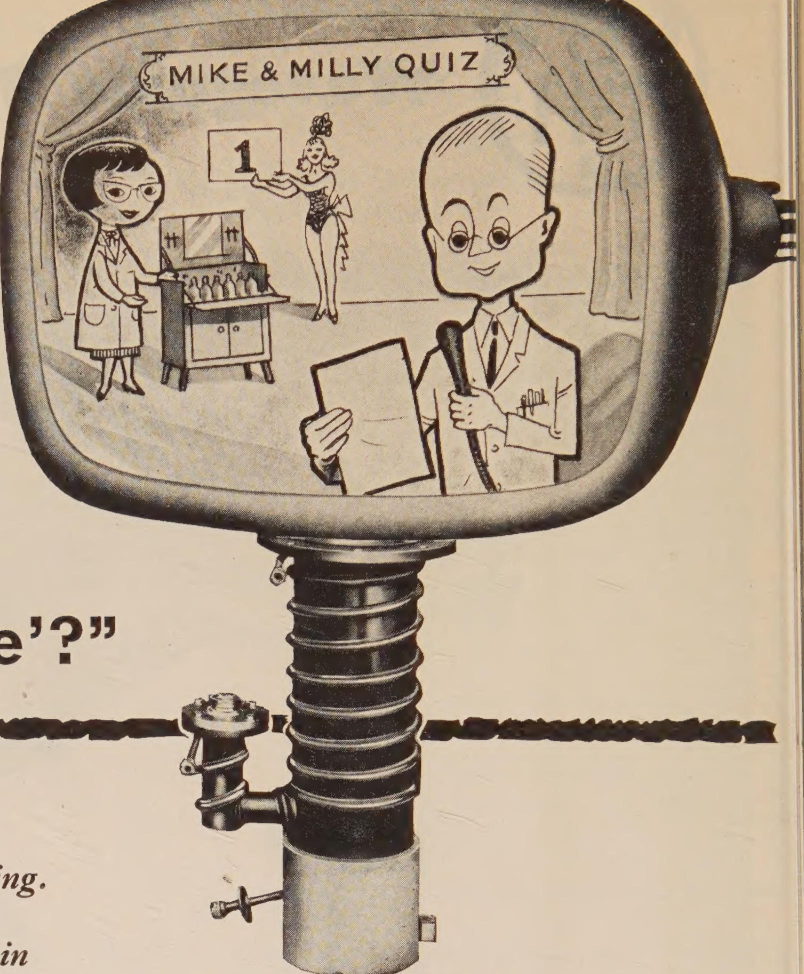

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Volume 62 MAY 1959 Number 737

ASTROPHYSICS

521.13

4197. ON A CASE OF THE ELIMINATION OF THE PURE SECULAR TERM INTRODUCED INTO THE THIRD ORDER PERTURBATION OF THE MAJOR AXES BY THE COEFFICIENT OF NULL ARGUMENT IN THE PERTURBATION FUNCTION. J.Meffroy.
C. R. Acad. Sci. (Paris), Vol. 247, No. 12, 863-5 (Sept.22, 1958).
In French.

Such an elimination is carried out for the three-body problem when the eccentricities are zero but the inclinations may be considerable. G.A.Chisnall

522.6

4198. MOVEMENT AND ADJUSTMENT OF THE NEW STELLAR SPECTROGRAPH AT THE ASTRONOMICAL OBSERVATORY AT MERATE. S.Guidarelli.
Atti Fond. Ronchi, Vol. 13, No. 6, 499-516 (Nov.-Dec., 1958).
In Italian.

Design details of the moving parts of the spectrograph are given. The accuracy required for each adjustment and scale is emphasized and the method used to attain these requirements described. R.W.Fish

523.11

4199. ON THE COSMOLOGICAL TIME SCALE.
C.Carstens/Hilbig.
Z. Naturforsch., Vol. 12a, No. 8, 659-60 (1957). In German.

In a discussion of relations between the constants of micro- and macro-physics, use is made of the elementary length e^2/m_ec^2 and of the gravitational radius of the proton. Quantities such as the gravitational constant, the total number of protons, the mass and volume of the universe are expressed in terms of microphysical constants and of the age of the universe. R.A.Newing

523.11

4200. RELATIVISTIC AND NEWTONIAN COSMOLOGY. A.Raychaudhuri.
Z. Astrophys., Vol. 43, No. 3, 161-4 (1957).

The similarity between the equations of relativistic and Newtonian cosmologies, as deduced respectively by the present author (Abstr. 5818/1955) and Heckmann and Schücking (Abstr. 870/1956), is pointed out. The work of Heckmann and Schücking is extended to a more general case, and a comparison is made between relativistic and Newtonian possibilities.

523.152.2

4201. INTERSTELLAR GAS AND STAR CREATION. S.van den Bergh.
Z. Astrophys., Vol. 43, No. 4, 236-44 (1957).

Recent observations indicate that both the galaxy and the Andromeda nebula contain surprisingly little interstellar gas. Calculations which take into account the ejection of matter from evolving stars and assume a constant rate of star production show that, if no external supply is available, the gas in the solar vicinity will be exhausted about 7×10^8 years from now. The amount of gas in the galactic nucleus is between 250 and 300 times smaller than the amount one would expect to have been ejected in 5×10^9 years from stars created with a luminosity function similar to that with which stars are formed in the solar vicinity. The most plausible explanation for this deficiency is that large quantities of gas have escaped (and are still escaping) from the galactic nucleus. The present rate of gas loss from the nucleus is estimated to be of the same order of magnitude as the rate at which gas is being lost from spiral arms by star formation. This suggests that the spiral arms of the galaxy may be continually rejuvenated by an outward flow of gas from the nucleus.

523.152.3

4202. DYNAMICS OF THE INTERPLANETARY GAS AND MAGNETIC FIELDS. E.N.Parker.
Astrophys. J., Vol. 128, No. 3, 664-76 (Nov., 1958).

The dynamical consequences are considered of Biermann's suggestion that gas is often streaming outward in all directions from the sun with velocities of the order of 500-1500 km/sec. These velocities of 500 km/sec and more and the interplanetary densities of 500 ions/cm^3 (10^{14} gm/sec mass loss from the sun) follow from the hydrodynamic equations for a 3×10^6 °K solar corona. It is suggested that the outward-streaming gas draws out the lines of force of the solar magnetic fields so that near the sun the field is very nearly in a radial direction. Plasma instabilities are expected to result in the thick shell of disordered field (10^{-5} gauss) inclosing the inner solar system, whose presence has already been inferred from cosmic-ray observations.

523.162

4203. POLARIZATION OF STARLIGHT BY FERROMAGNETIC PARTICLES. J.Henry.
Astrophys. J., Vol. 128, No. 3, 497-507 (Nov., 1958).

In an attempt to explain interstellar polarization by scattering and absorption of starlight by oriented dust particles, Davis and Greenstein's (1951) relaxation mechanism is generalized to ferromagnetic particles. It is shown that a magnetic field of about 10^{-6} oersted is sufficient to align the particles so as to produce the observed ratio of polarization to colour excess.

523.162

4204. POLARIZATION OF STARLIGHT: THE TORQUE ON A NUTATING GRAIN. L.Davis, Jr.
Astrophys. J., Vol. 128, No. 3, 508-9 (Nov., 1958).

It is shown that the formula used by Davis and Greenstein (1951) for the torque on a nutating isotropic paramagnetic dust grain in a magnetic field is essentially exact when the imaginary part of the susceptibility is proportional to the frequency and is small compared to the real part, which is independent of frequency. Thus this formula is not approximate, as previously supposed.

523.162

4205. ON THE THEORY OF THE POLARIZATION OF STARLIGHT BY INTERSTELLAR DUST. O.Zimmermann.
Z. Naturforsch., Vol. 12a, No. 8, 647-57 (1957). In German.

Stevenson's theory of electromagnetic scattering (Abstr. 617-18/1954) is used to estimate absorption and polarization by a cloud of prolate spheroidal iron particles whose linear dimensions are of order 10^{-5} cm. Reasonable assumptions are made concerning the distribution laws for particle size and axis orientation. Comparison with observation leads to estimates of distribution law parameters, particle eccentricities and the densities of dust clouds. The extension of the investigation to particles of larger size is considered. R.A.Newing

523.164 : 551.510.535 : 621.396.822

STUDIES OF COSMIC RADIO NOISE ON 25 Mc/s AT AHMEDABAD. See Abstr. 4129

523.164.3

4206. A SEARCH FOR RADIO EMISSION FROM METEORS.
G.S.Hawkins.
Astrophys. J., Vol. 128, No. 3, 724-6 (Nov., 1958).

There is a possibility that meteors might produce radio noise by means of a plasma resonance within the trail or by other mechanisms. Attempts have been made to detect radio emission from meteors at several points in the electromagnetic spectrum. Experiments carried out at frequencies of 475 and 218 Mc/s detected no radio noise that could be attributed to the occurrence of a meteor. At a frequency of 30 Mc/s, a few noise pulses were detected, but it was not definitely established that they were produced by direct radiation from the meteor. Over the frequency range 218-475 Mc/s the efficiency of conversion of kinetic energy into electromagnetic radiation is less than 10^{-18} per unit band width.

523.164.32

4207. PRELIMINARY REPORT ON POSITIONAL FLUCTUATIONS OF SOLAR RADIO SOURCES ON 200 Mc/s. P.Maltby.
Astrophys. Norveg., Vol. 6, No. 7, 75-84 (Dec., 1958).

Fluctuations in the apparent position of solar radio sources on 200 Mc/s were studied, using observations obtained with the phase-switched interferometer at the Solar Observatory, Harestua, Oslo. Observations were performed from February to September 1958. Results: (1) the analysis indicates that the magnitude of the positional fluctuations depends on whether the solar radio source is closely connected with a magnetic field in the active region or not; (2) no increase in the magnitude of the fluctuations in position as the source moved towards the solar limb is found on 200 Mc/s. Possible interpretations of the observational results are discussed.

523.164.32

4208. ON THE FEATURES OF STORM BURSTS IN THE 200 Mc/s RANGE. Ø.Elgarøy and Ø.Hauge.
Astrophys. Norveg., Vol. 6, No. 8, 85-92 (Dec., 1958).

Measurements were made of the duration of short lived pips occurring during noise storms. The pips tend to occur in groups and the mean time distance between successive pips in such groups is found. The recorded shape of the pips is discussed and a function fitting the mean curve derived. The received radiation seems to contain some preferred frequencies which change with time. By means of correlation analysis and a supposed pip-model the mean half-power bandwidth is calculated to be about 4 Mc/s.

523.164.85 : 538.566.2

4209. OBSERVATIONS OF DIRECTION OF ARRIVAL OF LONG-DURATION METEOR ECHOES IN FORWARD SCATTER PROPAGATION. T.Hagfors and B.Landmark.
J. geophys. Res., Vol. 64, No. 1, 19-22 (Jan., 1959).

The angular distribution of enduring meteor bursts in forward scattering is studied and compared with the angular distributions observed for the short duration meteor bursts and the turbulent background component. It is concluded that the enduring, fading bursts are due to meteor trails which reflect in a specular manner throughout the time during which they can be observed.

523.3

4210. CHANGES IN THE EARTH—MOON SYSTEM THROUGH TIDAL FRICTION IN THE PAST IN THE CASE OF A TIME-DEPENDENT GRAVITATIONAL CONSTANT. H.Gerstenkorn.
Z. Astrophys., Vol. 42, No. 3, 137-55 (1957). In German.

The value of the gravitational constant is assumed to be inversely proportional to the age of the universe. The influence of this time-dependence upon angular momentum exchange within the earth—moon system, and upon the mechanism of tidal friction, is discussed. The initial state of the system is estimated to be from 0.6 to 0.8 × 10^9 years ago, the duration of tidal friction being much shorter than in previous estimates. It is concluded that the moon is an independent celestial body captured by the earth within geological time. It is shown that the results remain substantially unchanged when allowance is made for the effect upon the angular momentum of the system of the solar gravitational field.

R.A.Newing

523.46

4211. ON THE MASS-DISTRIBUTION IN THE INTERIORS OF THE JOVIAN PLANETS. G.Fielder and R.Kurth.
Z.Astrophys., Vol. 44, No. 2, 106-11 (1958).

Formulae for the densities at certain levels in the interiors of mass-distributions of spherical symmetry are derived by means of Gauss' quadrature formulae. They are checked by application to two artificial planetary models and to the earth, and have been applied to the Jovian planets, for which they probably yield reliable estimates.

523.5 : 538.566.2

ELECTROMAGNETIC SCATTERING BY LOW-DENSITY METEOR TRAILS. See Abstr. 3675

523.51

4212. RARE GASES AND THEIR ISOTOPE SHIFT IN THE IRON METEORITE TREYSA. W.Gentner, H.Fechtig and G.Kistner.
Z. Naturforsch., Vol. 13a, No. 7, 569-70 (July, 1958). In German.

A difference in the argon and helium isotope ratios is found for the interior and exterior of this meteorite.

J.M.Hough

523.5

4213. SCANDIUM-45 AS A REACTION PRODUCT OF HIGH-ENERGY PARTICLES IN IRON METEORITES. I. H.Wänke.
Z. Naturforsch., Vol. 13a, No. 8, 645-9 (Aug., 1958). In German.

The scandium value of three iron meteorites was found to be 10^{-9} g Sc/g by neutron activation analysis. The concentrations we simply related to the concentrations of helium and neon isotopes, which confirms that Sc^{45} was produced by high-energy particles.

J.M.Houg

523.53 : 551.510.535 : 621.396

METEORS AND E_S IONIZATION. See Abstr. 4130

523.7

4214. GRANULATION AND OSCILLATIONS OF THE SOLAR ATMOSPHERE. C.Whitney.
Smithsonian Contrib. Astrophys., Vol. 2, No. 12, 365-76 (1958).

The observations of solar granulation are briefly summarized and their interpretation is discussed. Steady-state solutions of the linearized equations of motion in two dimensions, subject to the boundary condition of an oscillating corrugation at the bottom of th solar atmosphere, are obtained and their observable properties outlined. Two points are emphasized. First, the motions of the solar atmosphere cannot be pure compression-waves, even in the region stable against convection. They should be considered as a mixture of compressional and gravitational waves. Second, a physical interpretation of granulation requires the determination, with time-resolved spectra, of the phase relations between brightness and velocity.

523.745 : 550.38

4215. ON THE ORIGIN OF THE LONG-LIVED SOLAR CORPUSCULAR STREAMS WHICH APPEARED LAST SOLAR CYCLE 1950 TO 53. K.Sinno.
J. Radio Res. Lab. (Tokyo), Vol. 4, 25-35 (Jan., 1957).

In the decreasing epoch of solar activity (1949-1954), recurrences of the geomagnetic variation developed without exception. I was found that the autocorrelation coefficients of the international magnetic character figures C were repeated over 12 cycle waves which reached maxima at or near equinoxes during this period. It was verified through investigation by the Bertels's 27-day diagram that the vernal and autumnal maxima belonged to different series o the recurrences which appeared alternately in this period. For explanation of the above phenomena, the correlations between geomagnetic activities and solar coronal intensities are examined. It is concluded that the heliographic latitude of coronal intensity and the geomagnetic variation play an important role in these correlations. The corona directed to the earth (e.g. the northern corona in autum when the earth comes to the north of the heliographic equator and t southern corona in spring when the earth comes to the south of the heliographic equator) show negative correlation with the geomagnet variation. The position and speed of the corpuscular stream which affects the geomagnetic variation are discussed from the standpoint of inter-correlations with the geomagnetic variation.

523.746.

4216. WIDTH BROADENING OF SUNSPOT ZONES.
W. Gleissberg.
Z. Astrophys., Vol. 46, No. 4, 219-23 (1958). In German.

The width of the sunspot belts changes systematically during each eleven-year cycle. A rapid broadening (initial phase) is followed by a slower shrinking (final phase). The width of the sunspot be attains its maximum generally earlier than the spot activity. The amount of the maximum width depends slightly on the intensity of the sunspot maximum. During the initial phase the lower border of the spot belt shifts rapidly towards the equator whereas its upper border moves slightly into the opposite direction. During the final phase the lower border remains in the immediate neighbourhood of the equator; now, its upper border shifts steadily towards the equator. It is supposed that these features of the sunspot belts res from a sequence of belt migrations from high to low latitudes.

523.7

4217. CROCHET-ASSOCIATED FLARES.
H.W.Dodson and E.R.Hedeman.
Astrophys. J., Vol. 128, No. 3, 636-45 (Nov., 1958).

Flares associated with geomagnetic crochets in the interval 1949-1954 were of high average importance but exhibited an atypica distribution on the solar disk, with reduced frequency near the centre. The crochet-flares in this interval were not identical with flares associated with "major" sudden ionospheric disturbances. There was a close relationship between crochet-flares and flares with wide Hα at maximum. Average geomagnetic indices rose to a high maximum on day 2 following crochet-flares with "major early bursts" at radio frequency ≤ 200 Mc/s but not after crochet-flares in general.

523.75

4218. ON THE STABILITY OF A HYDROMAGNETIC PROMINENCE MODEL. A.Brown.
Astrophys. J., Vol. 128, No. 3, 646-63 (Nov., 1958).

The prominence material is treated as a compressible, inviscid fluid of high conductivity which is in static equilibrium under the usual hydromagnetic forces. For simplicity, a two-dimensional model is used. The equilibrium problem is shown to depend on a single partial-differential equation, and this is used to relate the solutions of the equilibrium problem proposed by different authors. The stability of one of these solutions is discussed in detail. A variational method is used to examine the characteristic value problem which arises when the equilibrium configuration is perturbed. It is found that the equilibrium solution is stable for vertical displacements and probably stable for horizontal displacements also, although in the latter case the results depend on the values of two parameters, and computations were carried out for only a selection of values of these parameters. The paper concludes with a discussion of the applicability of the solution concerned to observed types of prominence.

523.75

4219. THE FLARE OF SEPTEMBER 18, 1957.
J.T.Jefferies, E.v.P.Smith and H.J.Smith.
Astrophys. J., Vol. 129, No. 1, 146-63 (Jan., 1959).

A set of spectra of the disk flare of September 18, 1957, is discussed. The spectra, covering simultaneously a wavelength range of $\lambda\lambda$ 3900-7200 at a dispersion of ~ 2 A/mm, cover the period through the maximum phase. The Balmer lines reached a central intensity in excess of three times the neighbouring continuum and were at that time exceedingly wide. Several helium lines were in emission, including λ 4686 of He II, as well as the prominent neutral lines. The data indicate that the excitation conditions in the visible flare vary rapidly with depth and suggest that the visible flare is merely an extension of a more powerful excitation. The Balmer series wing shapes are shown to be compatible either with Stark effect or with a particular form of velocity field of macroscopic or microscopic motions.

523.75 : 550.385

4220. RECURRENT GEOMAGNETIC STORMS AND SOLAR PROMINENCES. R.T.Hansen.
J. geophys. Res., Vol. 64, No. 1, 23-5 (Jan., 1959).

A study is made of the run of areas of solar prominences around days of recurrent geomagnetic storms during the period 1917-1944. "Character figures for dark H-alpha flocculi", taken from I.A.U. Quarterly Bulletins of Solar Activity, are used as the measure of prominence areas. The earlier suggestions that the solar M-regions may be identified as quiescent prominences have not been confirmed.

523.75 : 550.385

4221. ON THE ASYMMETRY OF THE HELIOGRAPHIC DISTRIBUTION OF THE STORM-PRODUCING PROBABILITY OF FLARES.
Y.Hakura.
J. Radio Res. Lab. (Tokyo), Vol. 5, 57-64 (Jan., 1958).

The positional dependence of the storm-producing probability of flares on the solar disk is examined. An asymmetry of probability distribution was found, its being found superposed on the tendency of increasing probability towards the centre of the solar disk. The results support the concept of CCZ.

523.75

4222. THE LAW OF ROTATION OF (SOLAR) FILAMENTS.
U.Becker.
Z. Astrophys., Vol. 42, No. 1, 1-6 (1957). In German.

After correcting the proper motion of the filament, the derived rotational period agrees with that of both photospheric and chromospheric features. Thus the law is similar to that derived from the motion of sunspots. A re-discussion of non-spectroscopic observational data on the rotation of the emission corona suggests that an increase of the rotational velocity with level above the chromosphere is not proven. D.R.Barber

523.75

4223. THE FLARE AND ASCENDING PROMINENCE OF 4 JUNE 1956. W.Comper and R.Kern.
Z. Astrophys., Vol. 43, No. 1, 20-8 (1957). In German.

The motion of eruptive prominence material associated with eight readily-recognizable knots is discussed. Altitude—time relationships derived from observations of the individual condensations confirm the law of prominence motion found by Pettit. At an altitude of 3×10^5 km the velocity of the prominence material was ~ 512 km/sec. D.R.Barber

523.75

4224. OBSERVATION IN INTEGRATED LIGHT OF A SOLAR ERUPTION ON THE SOLAR LIMB.
K.O.Kiepenheuer and G.Kuenzer.
Z. Astrophys., Vol. 44, No. 2, 138-41 (1958). In German.

On 7 September 1957, a prominence-like feature was observed in integrated light in 18° northern latitude on the west limb of the sun from 8^{09} to 8^{11} U.T., which had an elevation of about 45" over the sun's limb. Its brightness exceeded that of the disk, while in the spectrohelioscope nothing conspicuous could be seen at the same location. The event which was followed by an intense limb flare occurred above an active spot group.

523.75

4225. STATISTICS OF SOLAR FLARES FROM 1945 TO 1954.
M.Waldmeier and H.Bachmann.
Z. Astrophys., Vol. 47, No. 2, 81-93 (1959). In German.

Statistical investigations of solar flares have been carried out through cycle No. 18 (1945-1954), using the material published in the Quarterly Bulletin on Solar Activity. Out of 4828 observed flares 79% are of importance 1, 18% of importance 2 and 3% of importance 3. The frequency of flares was found again to be proportional to the sunspot-numbers, but in cycle No. 18 the flare activity has dropped to 72% of that during cycle No. 17 (reduced to the same sunspot-number). The average lifetime of a flare is 22 min for importance 1, 45 min for importance 2 and 85 min for importance 3. The distribution of flares in heliographic latitude follows very closely that of the sunspot-groups. There is no systematic displacement between flares and spots larger than 0.2° in heliographic latitude. The frequency of flares decreases with increasing angular distance θ from the central meridian approximately proportionally to cos θ. The rate of decrease is only partially explained by foreshortening; chromospheric absorption has also to be taken into account. Flare activity is greater in the eastern than in the western hemisphere and shows a decrease in the interval $\theta = 11^\circ$ to 20°.

523.755

4226. SUPRATHERMAL PARTICLE GENERATION IN THE SOLAR CORONA. E.N.Parker.
Astrophys. J., Vol. 128, No. 3, 677-85 (Nov., 1958).

It is shown that hydromagnetic waves propagating outward through the solar corona will convert all but a small portion of their energy into suprathermal particles. It is suggested that this is the source of the 3×10^{28} ergs/sec necessary to maintain the 2×10^6 °K solar corona with its continued expansion into the solar wind. The temperature of the solar corona will then correspond to an ion thermal velocity of the same order of magnitude as the hydromagnetic wave velocity.

523.77

4227. SOME SPECTROGRAPHIC SOLAR OBSERVATIONS MADE IN JULY 1957. L.O.Lodén.
Ark. Astron., Vol. 2, Paper 22, 245-57 (1958).

A few interesting phenomena correlated to solar flares are studied in Hα with the grating spectrograph of the 20 metre horizontal telescope of the Swedish Astrophysical Station on Capri (Italy).

523.77

4228. INTERFEROMETRIC STUDY OF PROFILES OF FAINT FRAUNHOFER LINES. Z.Suemoto.
Monthly Not. Roy. Astron. Soc., Vol. 117, No. 1, 2-21 (1957).

Profiles of well isolated Fraunhofer lines in the red were measured interferometrically by crossing a Fabry—Perot interferometer (with dielectric coating) with the 9 m spectrograph of the Cambridge Observatories. The average effective resolving power was as high as 6×10^5. The wavelength distribution of the selective absorption coefficient was derived from the measured profiles, using Vitense's Model II. For every point of the disk faint lines give broader Doppler widths than do stronger lines. It is suggested that there is a circulation in the solar atmosphere, vertical upward motion in granules being converted into horizontal motion at about $\tau = 0.4$, and finally changing into downward motions back to the convection layer.

523.77

4229. ON THE INTERPRETATION OF THE RED-SHIFT AND THE CENTRE-LIMB VARIATION OF FRAUNHOFER LINES BY CONSIDERATION OF TEMPERATURE FLUCTUATIONS IN THE SOLAR ATMOSPHERE. E.H.Schröter.

Z. Astrophys., Vol. 41, No. 3, 141-81 (1957). In German.

The difference between relativistic and observed red-shifts is explained in terms of granular Doppler shifts with allowance for temperature fluctuations between granular and intergranular regions, the amount of these fluctuations being derived from an empirical inhomogeneous "two stream" model of the solar atmosphere. The model also provides good agreement with observed line strength dependent centre-limb variations. R.A.Newing

523.77

4230. HEIGHT GRADIENT OF THE EMISSION CORONA.

D.E.Billings and R.H.Cooper.

Z. Astrophys., Vol. 43, No. 3, 218-26 (1957).

Average height gradients from a large number of 5303 A coronal line spectrograms correspond to a corona in hydrostatic equilibrium at a temperature of 1.8×10^6 °K. Gradients from 6374 A average slightly higher. Gradients in individual cases vary widely, variation being greatest in the cases where 5694 A also appears. No clear-cut correspondence appears between λ 5303/λ 6374 ratio and height gradients, but the average gradients correspond to hydrostatic equilibrium at temperatures that are computed by means of a correlation previously found by one of the authors between λ 5303/λ 6374 ratio and line width.

523.82

4231. OBSERVATIONS ON THE WAVELENGTH DEPENDENCE OF INTERSTELLAR POLARIZATION. A.Behr.

Z. Astrophys., Vol. 47, No. 1, 54-8 (1959). In German.

The polarization in three colours (green, blue, violet) of some specially selected stars was measured. A small decrease towards shorter wavelengths in the degree of polarization was found in the case of γ Cas, ξ Per, ξ Per and ζ Oph; a flat maximum in the blue in the case of φ And and φ Per.

523.82

4232. THE COLOR DEPENDENCE OF THE POLARIZATION OF STARLIGHT. L.Davis, Jr.

Z. Astrophys., Vol. 47, No. 1, 59-66 (1959).

The theory of the colour dependence of the interstellar polarization of starlight is investigated. A maximum in the polarization as a function of wavelength is to be expected, since one expects very little polarization at extremely long and extremely short wavelengths. This seems consistent with Behr's observations (see preceding abstract). The effect of grain size, composition, and degree of alignment on the wavelength at which the maximum occurs are considered. Expressions useful for estimating the polarization and extinction produced by large grains are developed by approximate methods and some ways are considered in which one can reach correspondingly approximate conclusions about the size distribution of interstellar dust grains and the small influence of alignment on extinction.

523.852

4233. OBSERVATIONAL ASTROPHYSICS FROM ROCKETS.
I. NEBULAR PHOTOMETRY AT 1300 A.

J.E.Kupperian, Jr, A.Boggess III and J.E.Milligan.

Astrophys. J., Vol. 128, No. 3, 453-64 (Nov., 1958).

The techniques of rocket astronomy with photon counters has been advanced so that observations with 3° resolution are possible. A survey of the winter sky in the spectral region 1225-1350 A has been made with this resolution. Numerous extended sources of high surface brightness have been discovered. These sources tend to occur near O and B stars. A nebula, 22°.5 in diameter, around α Virginis is discussed. The flux at the earth from this nebula is 1×10^{-5} erg/cm²/sec, while α Vir itself has not been detected. An upper limit for the stellar flux is set at 2×10^{-7} erg/cm²/sec. Ordinary atomic recombination processes cannot account for the high nebular flux observed in this wavelength region. Collisional processes or the degradation of stellar energy above 912 A might provide an explanation.

523.852 : 539.18

4234. THE RECOMBINATION SPECTRUM OF NEBULAR HYDROGEN. L.Searle.

Astrophys. J., Vol. 128, No. 3, 489-96 (Nov., 1958).

The equilibrium populations of the (n,l) states of hydrogen, resulting from proton–electron recombination under nebular conditions, have been computed. The Menzel b(n,l) factors and the resulting Balmer decrements are tabulated. The calculations are based on approximate recombination coefficients, and recaptures onto levels $n > 10$ have been neglected. The b(n,l) are found to be str dependent on l, but the resulting decrements are only slightly les steep than those resulting from computations of the Cillié type. The decrement is found to be insensitive to the optical thickness the nebula in the Lyman lines.

523.

4235. SOME THEORETICAL ASPECTS OF H AND K EMISSIO IN LATE-TYPE STARS. F.Hoyle and O.C.Wilson.

Astrophys. J., Vol. 128, No. 3, 604-15 (Nov., 1958).

A velocity is defined in the subphotospheric convection zones late-type stars that varies from star to star in the same way as width of the emission lines H and K of Ca II. The quantity is tent tively identified as the velocity of hydromagnetic waves.

523.877 : 539

4236. AN OBSERVATIONAL TEST OF THE CARBON-CYCLE RATE. D.C.Morton.

Astrophys. J., Vol. 129, No. 1, 20-5 (Jan., 1959).

If there exists a low-energy resonance in the $N^{14}(p,\gamma)O^{15}$ reaction, the rate of the carbon cycle is faster by a factor of abou 100 than without such a resonance. To test the existence of the resonance, the luminosities and effective temperatures of theoreti models for unevolved stars using the two different reaction rates are compared with the observed initial main sequence in the Hertzsprung–Russell diagram. Although there are large uncerta ties in the comparison, the results distinctly favour no resonance over resonance.

523.

4237. HOMOLOGOUS SOLUTIONS OF EQUATIONS OF STELL STRUCTURE. G.J.Odgers.

Publ. Dominion Astrophys. Obs. Victoria, B.C., Vol. 10, No. 20, 393-406 (1958).

The equations of stellar structure regarded as a system of fo first-order differential equations were studied with the purpose o finding the conditions under which homologous solutions are possi The interest of this attempt lies in the fact that it is only when su solutions exist that a mass-luminosity law of simple analytical fo is valid. It is shown that the Russell–Vogt theorem on the unique of solutions of the equations of stellar structure is not rigorously true. In general, it appears that homologous solutions do not exis since the necessary and sufficient conditions imply in general a la of energy generation which is not physically correct. The law of energy generation implied by the standard model of Eddington is found and shown to be physically impossible. A theorem due to Strömgren which attempts to derive the Eddington mass-luminosi law from the basic equations, in the case of small radiation press by means of a set of homologous transformations is shown to be i valid.

523.8

4238. STUDIES ON STELLAR MODELS WITH PARTIALLY DEGENERATE CORES AND OUTER CONVECTIVE ZONES.

M.Shimoda and S.Obi.

Publ. Astron. Soc. Japan, Vol. 10, No. 1, 26-39 (1958).

The investigation takes account of the contribution of the ion pressure in the core. All models were computed for two differen contents of the heavy elements. The results are studied systemati cally in terms of the mass and the fraction of the mass contained the core, and it is shown that the models of the present kind are divided into two types. It is also found that the general character of the models is specified by the mass contained in the core, and that the fraction of the mass contained in the convective zone increases with increasing fraction of the core mass. The present models are compared with those of Hoyle–Schwarzschild.

523.8

4239. ON THE INSTABILITY OF SPHERICALLY SYMMETRIC GAS DISTRIBUTIONS. R.Ebert.

Z. Astrophys., Vol. 42, No. 4, 263-72 (1957). In German.

The instability of a self-gravitating gaseous cloud with respec to density perturbations is discussed and the critical wavelength for instability is derived from an eigenvalue problem in the case o an isothermal gaseous sphere. The smallest unstable masses for given temperature T_0 and central density ρ_0 are derived by numer ical integration; for suitable values of T_0 and ρ_0 results of the ord of O-type stellar masses are obtained. R.A.Newi

523.877

4240. THE MAGNITUDE OF THE "CONVECTION ELEMENT" [KONVEKTIONSELEMENTE] IN LAYERS WITH VARIABLE TEMPERATURE GRADIENT. K.H.Böhm.
Z. Astrophys., Vol. 46, No. 4, 245-56 (1958). In German.

The methods of determining the scale parameter ("mixing length") of the convection in the outer layers of a star are briefly reviewed. The usual assumption that the "mixing length" is equal to the scale height $RT/\mu g$ leads to difficulties. The structure of the solar hydrogen convection zone can be described in the following way: a very unstable layer with a thickness of about 500 km lies on top of a layer, which is at least 60 000 km thick but much less unstable. The difference between the actual and the adiabatic temperature gradient is higher by a factor of about 100 in the upper than in the lower layer of the convection zone. Under these conditions the "mixing length" in the upper parts of the convection zone is equal (as to the order of magnitude) to the thickness of the upper very unstable layer (i.e. 500 km). This effect is illustrated by a simple calculation of the Rayleigh type. Numerical results concerning the convective instability of a polytropic atmosphere (extending the earlier results of Skumanich to the case $\Gamma = 2$) are also given.

523.877

4241. STAR MODELS. I. THE EVOLUTION OF TYPE II STARS. R.Kippenhahn, S.Temesváry and L.Biermann.
Z. Astrophys., Vol. 46, No. 4, 257-75 (1958). In German.

Quasi-stationary stellar models are calculated by straightforward integration beginning from surface conditions in the atmosphere to a fit according to the given central conditions. In the outer part of the hydrogen convection zone both radiative and convective transport of energy have been taken into account. A general programme for calculations of this type has been developed for an electronic computer. The present paper is an attempt to repeat the Hoyle—Schwarzschild calculations concerning the evolution of type II stars. The same values for the mass ($M = 1.2\ M_{\odot}$) and for the chemical composition have been used, and also the same fitting-conditions of the shell-source. The results are in fair agreement with the former ones for the first part of the evolutionary sequence in which the influence of the hydrogen convection zone on the structure is negligible. The following part of the evolutionary track shows no rise into the supergiant region as obtained by Hoyle and Schwarzschild, but follows a smooth path through the region of the normal giants. This means that the right hand border of the H—R-diagram is reached without getting a central temperature sufficient for helium burning. This discrepancy with the former results is due to the smaller effectiveness of the convective zone as calculated by explicit integration of the nonadiabatic part of the zone. The observed H—R-diagrams of globular clusters lie within the range of acceptable values of chemical composition and ratios of mixing length to scale height, but the metal content probably has to be assumed smaller than has been done by Hoyle and Schwarzschild.

523.877 : 532.5 : 538.3

EXAMPLES OF GAS MOTION AND CERTAIN HYPOTHESES ON THE MECHANISM OF STELLAR OUTBURSTS. See Abstr. 3661

525.14

4242. EARTH OBLATENESS IN TERMS OF SATELLITE ORBITAL PERIODS. L.Blitzer.
Science, Vol. 129, 329-30 (Feb. 6, 1959).

A theoretical equation relating the earth's oblateness to the anomalistic and nodical periods and orbit parameters of an earth satellite is presented. In the absence of exact data on nodical periods, Vanguard prediction data are utilized to obtain a check calculation for the oblateness and to establish the validity of the method.

525.3 : 621.396.946

4243. THE DETERMINATION OF THE ORBITS OF EARTH SATELLITES FROM MEASUREMENTS OF DOPPLER EFFECT. W.Priester and G.Hergenhahn.
Wiss. Abhandl. Arbeitsgemeinschaft Forsch. Landes Nordrhein-Westfalen, Vol. 8, 38 pp. (1958). In German.

See Abstr. 3662 (1958). The geometry of three-station observation of Doppler effect of the radio transmissions of an earth satellite is examined. The observations at each station consist of the epoch and tangent slope of the stationary point of the frequency—time plot. An iterative method for determining the orbital elements is discussed. Brief mention is made of ionospheric refraction.

M.W.Ovenden

526.918 : 771.35

4244. INFLUENCE OF THE DISTORTION OF AN OBJECTIVE IN AERO-TRIANGULATION AND AERO-SURVEY.
F.Camps and M.Lepropre.
Bull. Soc. Roy. Sci. Liege, Vol. 26, No. 6, 299-313 (June, 1957). In French.

For extensive photogrammetric surveys cameras with wide-angle objectives are used and these usually are subject to distortion. The case where the ground is horizontal and the viewing stations are equidistant along the same horizontal line, with the camera axis vertical, is considered theoretically and treated by the method of Pauwen. It is shown that the distortion directly affects the longitudinal inclination and introduces a systematic error. The results of an experimental verification are described. S.Weintroub

PHYSICS

GENERAL

53

4245. MICHELSON ON MEASUREMENT. R.Lagemann.
Amer. J. Phys., Vol. 27, No. 3, 182-4 (March, 1959).

At various times Michelson attributed to an unnamed physicist the remark ".... the future truths of Physical Science are to be looked for in the sixth place of decimals". The circumstances surrounding this famous comment are related, and the hypothesis is offered that it was Maxwell, or possibly Kelvin, whom Michelson was quoting.

53

4246. ANNIVERSARIES IN 1959 OF INTEREST TO PHYSICISTS. E.S.Barr.
Amer. J. Phys., Vol. 27, No. 4, 209-33 (April, 1959).

During the year 1959 there will be major anniversaries of birth or death for 22 men who have contributed importantly to the development of physics. Brief accounts of their lives and contributions are presented here.

53

4247. IMPROVING THE QUALITY OF SCIENCE INSTRUCTION IN ELEMENTARY AND SECONDARY SCHOOLS. H.A.Smith.
Amer. J. Phys., Vol. 27, No. 4, 259-63 (April, 1959).

This paper discusses the training of a science teacher and some factors accounting for so much ineffective science instruction. Some ways to improve the situation are suggested. The paper highlights some of the common misunderstandings and tries to establish a basis for more effective cooperation between scientists and educators.

53.083.3 : 621.317.715

4248. NUMERICAL INTEGRATION APPLIED TO THE GALVANOMETER EQUATION. D.D.Woodbridge.
Amer. J. Phys., Vol. 27, No. 4, 267-70 (April, 1959).

An exact solution of the ballistic galvanometer equation, without any assumptions, has been impossible until the development of numerical analysis methods. A set of predictor and corrector equations was developed so that the theoretical motion of the galvanometer coil can be calculated for any type or combination of impulses. The galvanometer equation was solved for a 16 sec period, ballistic galvanometer. The equation was solved for sine wave, capacitor discharge, square wave, and double sine-wave impulses.

53.087 : 681.142

4249. DATA RECORDING. SUMMARY OF A CONFERENCE HELD AT A.E.R.E. ON 3RD OCTOBER, 1958. R.C.M.Barnes.
Atomic Energy Res. Establ. (Harwell) Rep. EL/R2775, 14 pp. (1958).

Summarizes the proceedings of a conference which discussed data handling systems in which data from experiments is recorded in analogue or digital form on magnetic tape, analysed in specialized instruments, and finally transferred to digital computers for the remaining stages of data processing.

53.088

4250. APPLICATION OF LOGARITHMIC CORRELATION TO PHYSICAL EXPERIMENTS.
M.Castañs Camargo and M.Medina e Isabel.
An. Real Soc. Espan. Fis. Quim., Vol. 54(A), No. 11-12, 363-72 (Nov.-Dec., 1958). In Spanish.

The correlation coefficients introduced in a previous paper

530.145

4278. A REAL SPINOR FORMALISM IN THE THEORY OF THE ELECTRON. P.Merat.
C.R. Acad. Sci. (Paris), Vol. 248, No. 4, 533-5 (Jan. 26, 1959).
In French.

Gives a real eight-component spinor theory, claimed to be equivalent to Dirac theory. Invariance considerations suggest the introduction of two new four-vector potentials in analogy to the electromagnetic potential. R.J.N.Phillips

530.145

4279. PHENOMENOLOGICAL TWO-NUCLEON POTENTIALS AND THE DEUTERON. K.V.Laurikainen.
Nuclear Phys., Vol. 8, No. 2, 210-12 (Sept. [2], 1958).

The results are given of some preliminary calculations on the bound states of the two-nucleon system, using the Gammel—Thaler potential, mainly with the object of studying the effect of the LS term in the potential. As required by experiment, the system has no bound states other than the $^3S + {}^3D$ state. However, variational calculations on this state, using a potential in which the hard core is replaced by a zero cut off in the LS term, indicate that this term will modify the results obtained with the Gammel—Thaler potential, and lead to wrong values for the binding energy and quadrupole moment of the deuteron. E.J.Squires

530.145

4280. CONSTRUCTION OF THE DIRAC EQUATION CENTRAL POTENTIAL FROM PHASE SHIFTS AND BOUND STATES.
F.Prats and J.S.Toll.
Phys. Rev., Vol. 113, No. 1, 363-70 (Jan. 1, 1959).

The connection between phase shifts, bound-state energies, and the potential is studied for a Dirac particle in a spherically symmetric potential. An explicit method is developed for the construction of the potential from the scattering and bound-state data for a single angular momentum and parity. The technique used in this relativistic problem is an extension, appropriately generalized to matrices, of the methods used by Jost and Kohn for the nonrelativistic case. For potentials with $\int_0^\infty r^n |V(r)| \, dr$ finite for n = 0, 1, and 2, it is shown that a spectral function can be constructed from the phase shifts, the bound-state energies, and the norm of the bound-state wave functions. A generalization of the Gel'fand and Levitan method is developed for the determination of the potential from the spectral function. First, eigenvectors associated with two different potentials are related; from the operator that connects the two systems of eigenfunctions, a modified kernel is defined which satisfies an integral equation determined by the spectral function and eigenfunctions corresponding to a "comparison potential" and the spectral function associated with the "unknown potential". Second, the potential difference is obtained by the differentiation of a certain combination of the elements of the modified kernel. These properties lead to the following method for the construction of the potential: (1) the spectral function is determined from the data for both positive and negative energies;
(2) with the spectral function for the unknown potential and the spectral function and eigenfunctions of a convenient comparison potential, the integral equation for the modified kernel is constructed;
(3) from the solution of the integral equation the difference between the unknown and the comparison potentials is determined.

530.145

4281. INVARIANCE IN ELEMENTARY PARTICLE PHYSICS.
N.Kemmer, J.C.Polkinghorne and D.L.Pursey.
Rep. Progr. Phys., Vol. 22, 368-432 (1959).

An account, as non-technical as possible, is given of the invariance properties that have important applications in elementary particle physics. These can be classified in several ways. Firstly, some are related to continuous groups (rotations), others to discrete groups (inversions). Secondly, some are related to groups of well known geometrical or kinematical significance (ordinary space time), others are not and are peculiar to elementary particle physics (isobaric space). Finally, some are, it appears, rigorously valid while others are of approximate nature. The discussion aims to cover all cases and their interpretation. In as far as possible explicit use of quantum field theory techniques is avoided.

530.145

4282. EQUATIONS OF MOTION OF POINT PARTICLES IN FIELDS OF NONZERO REST MASS AND SPIN. P.Havas.
Phys. Rev., Vol. 113, No. 2, 732-40 (Jan. 15, 1959).

A classical theory of free fields corresponding to quanta of arbitrary integral spin was formulated by Dirac and Fierz. Sources of such neutral fields were considered by Harish—Chandra, who also obtained the equations of motion for arbitrary multipole singularities. It is noted that for fields of nonzero rest mass and spin the conditions imposed on the sources by Harish—Chandra are more stringent than is required by the invariance properties of the fields and a more general set of equations is proposed. The correspondin equations of motion are obtained for arbitrary multipole singularities. The theory is extended to charged and charge-symmetric fields.

530.14

4283. THE APPROXIMATE STATE VECTOR FOR A CLOTHED NUCLEON IN THE INTERMEDIATE COUPLING APPROXIMATION.
J.Mandelbrojt.
C. R. Acad. Sci. (Paris), Vol. 248, No. 4, 530-3 (Jan. 26, 1959).
In French.

The necessary and sufficient conditions for the Tomonaga intermediate coupling approximation to give exactly the nucleon ground state is written down. The resulting system of equations is solved. J.C.Taylor

530.145 : 539.14

4284. APPLICATION OF PERTURBATION METHODS TO THE THEORY OF NUCLEAR MATTER. D.J.Thouless.
Phys. Rev., Vol. 112, No. 3, 906-22 (Nov. 1, 1958).

A generalized perturbation theory is developed in such a way that it can be applied to a many-body problem with strong forces between the particles. The Brueckner expression for the energy is shown to be the first-order term in a particular case of this expansion. Some of the higher-order terms in the expansion are studied, and the importance of self-consistency in the energy denominator of Brueckner's equation and of the use of the exclusion principle in intermediate states is assessed. A possible simplification of the methods used is suggested, which involves solving the Brueckner equation for the hard core, and using normal perturbation theory for the attractive part of the potential. The methods developed are used to analyse some details of previously published calculations. The lack of equality between the Fermi energy and the binding energy in the nuclear matter calculations shows that there must be a rearrangement energy. A simple formula for the rearrangement energy is derived, and its importance for single-particle excited states, such as occur in the optical model, is shown. The relation between the rearrangement energy and the departure of the system from a degenerate Fermi-gas state is shown. The effect of the rearrangement energy on the ground-state energy is indirect, but it is as important as the self-consistency condition. The rearrangement energy seems to come mainly from the hard core, and simple numerical estimates of the rearrangement energy from a hard core potential show that it is somewhat less than 16 MeV at the Fermi surface. The ground-state energy is reduced by perhaps 1 MeV. There seems to be a discrepancy between the calculated and observe energy dependence of the real part of the optical model potential.

530.145

4285. DISPERSION RELATION FOR NONRELATIVISTIC POTENTIAL SCATTERING. B.W.Lee.
Phys. Rev., Vol. 112, No. 6, 2122-4 (Dec. 15, 1958).

A new dispersion relation for nonrelativistic potential scattering, when the potential has a finite extent, is derived by completing the contours of integration along a semicircle of infinite radius in the lower half of the complex λ plane ($\mathrm{Re}\lambda = k$). The residue terms then explicitly exhibit the contributions from virtual states and radioactive decaying states. Resemblance between the residue term arising from a radioactive decaying state and the Breit—Wigner resonance formula is noted and the Breit—Wigner formula is shown to follow correctly from the analytic properties of the S matrix.

530.145

4286. p—p S-WAVE PHASE SHIFTS FROM A BOUNDARY CONDITION POTENTIAL. M.H.MacGregor.
Phys. Rev. Letters, Vol. 2, No. 3, 106-7 (Feb. 1, 1959).

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530.145

4278. A REAL SPINOR FORMALISM IN THE THEORY OF THE ELECTRON. P.Merat.

C.R. Acad. Sci. (Paris), Vol. 248, No. 4, 533-5 (Jan. 26, 1959).
In French.

Gives a real eight-component spinor theory, claimed to be equivalent to Dirac theory. Invariance considerations suggest the introduction of two new four-vector potentials in analogy to the electromagnetic potential. R.J.N.Phillips

530.145

4279. PHENOMENOLOGICAL TWO-NUCLEON POTENTIALS AND THE DEUTERON. K.V.Laurikainen.

Nuclear Phys., Vol. 8, No. 2, 210-12 (Sept. [2], 1958).

The results are given of some preliminary calculations on the bound states of the two-nucleon system, using the Gammel–Thaler potential, mainly with the object of studying the effect of the LS term in the potential. As required by experiment, the system has no bound states other than the $^3S + {}^3D$ state. However, variational calculations on this state, using a potential in which the hard core is replaced by a zero cut off in the LS term, indicate that this term will modify the results obtained with the Gammel–Thaler potential, and lead to wrong values for the binding energy and quadrupole moment of the deuteron. E.J.Squires

530.145

4280. CONSTRUCTION OF THE DIRAC EQUATION CENTRAL POTENTIAL FROM PHASE SHIFTS AND BOUND STATES.

F.Prats and J.S.Toll.
Phys. Rev., Vol. 113, No. 1, 363-70 (Jan. 1, 1959).

The connection between phase shifts, bound-state energies, and the potential is studied for a Dirac particle in a spherically symmetric potential. An explicit method is developed for the construction of the potential from the scattering and bound-state data for a single angular momentum and parity. The technique used in this relativistic problem is an extension, appropriately generalized to matrices, of the methods used by Jost and Kohn for the nonrelativistic case. For potentials with $\int_0^\infty r^n|V(r)|\,dr$ finite for n = 0, 1, and 2, it is shown that a spectral function can be constructed from the phase shifts, the bound-state energies, and the norm of the bound-state wave functions. A generalization of the Gel'fand and Levitan method is developed for the determination of the potential from the spectral function. First, eigenvectors associated with two different potentials are related; from the operator that connects the two systems of eigenfunctions, a modified kernel is defined which satisfies an integral equation determined by the spectral function and eigenfunctions corresponding to a "comparison potential" and the spectral function associated with the "unknown potential". Second, the potential difference is obtained by the differentiation of a certain combination of the elements of the modified kernel. These properties lead to the following method for the construction of the potential: (1) the spectral function is determined from the data for both positive and negative energies;
(2) with the spectral function for the unknown potential and the spectral function and eigenfunctions of a convenient comparison potential, the integral equation for the modified kernel is constructed;
(3) from the solution of the integral equation the difference between the unknown and the comparison potentials is determined.

530.145

4281. INVARIANCE IN ELEMENTARY PARTICLE PHYSICS.

N.Kemmer, J.C.Polkinghorne and D.L.Pursey.
Rep. Progr. Phys., Vol. 22, 368-432 (1959).

An account, as non-technical as possible, is given of the invariance properties that have important applications in elementary particle physics. These can be classified in several ways. Firstly, some are related to continuous groups (rotations), others to discrete groups (inversions). Secondly, some are related to groups of well known geometrical or kinematical significance (ordinary space time), others are not and are peculiar to elementary particle physics (isobaric space). Finally, some are, it appears, rigorously valid while others are of approximate nature. The discussion aims to cover all cases and their interpretation. In as far as possible explicit use of quantum field theory techniques is avoided.

530.145

4282. EQUATIONS OF MOTION OF POINT PARTICLES IN FIELDS OF NONZERO REST MASS AND SPIN. P.Havas.

Phys. Rev., Vol. 113, No. 2, 732-40 (Jan. 15, 1959).

A classical theory of free fields corresponding to quanta of arbitrary integral spin was formulated by Dirac and Fierz. Sources of such neutral fields were considered by Harish–Chandra, who also obtained the equations of motion for arbitrary multipole singularities. It is noted that for fields of nonzero rest mass and spin the conditions imposed on the sources by Harish–Chandra are more stringent than is required by the invariance properties of the fields and a more general set of equations is proposed. The correspondin equations of motion are obtained for arbitrary multipole singularities. The theory is extended to charged and charge-symmetric fields.

530.14

4283. THE APPROXIMATE STATE VECTOR FOR A CLOTHED NUCLEON IN THE INTERMEDIATE COUPLING APPROXIMATION.

J.Mandelbrojt.
C. R. Acad. Sci. (Paris), Vol. 248, No. 4, 530-3 (Jan. 26, 1959).
In French.

The necessary and sufficient conditions for the Tomonaga intermediate coupling approximation to give exactly the nucleon ground state is written down. The resulting system of equations is solved. J.C.Taylor

530.145 : 539.14

4284. APPLICATION OF PERTURBATION METHODS TO THE THEORY OF NUCLEAR MATTER. D.J.Thouless.

Phys. Rev., Vol. 112, No. 3, 906-22 (Nov. 1, 1958).

A generalized perturbation theory is developed in such a way that it can be applied to a many-body problem with strong forces between the particles. The Brueckner expression for the energy is shown to be the first-order term in a particular case of this expansion. Some of the higher-order terms in the expansion are studied, and the importance of self-consistency in the energy denominator of Brueckner's equation and of the use of the exclusion principle in intermediate states is assessed. A possible simplification of the methods used is suggested, which involves solving the Brueckner equation for the hard core, and using normal perturbation theory for the attractive part of the potential. The methods developed are used to analyse some details of previously published calculations. The lack of equality between the Fermi energy and the binding energy in the nuclear matter calculations shows that there must be a rearrangement energy. A simple formula for the rearrangement energy is derived, and its importance for single-particle excited states, such as occur in the optical model, is shown. The relation between the rearrangement energy and the departure of the system from a degenerate Fermi-gas state is shown. The effect of the rearrangement energy on the ground-state energy is indirect, but it is as important as the self-consistency condition. The rearrangement energy seems to come mainly from the hard core, and simple numerical estimates of the rearrangement energy from a hard core potential show that it is somewhat less than 16 MeV at the Fermi surface. The ground-state energy is reduced by perhaps 1 MeV. There seems to be a discrepancy between the calculated and observe energy dependence of the real part of the optical model potential.

530.145

4285. DISPERSION RELATION FOR NONRELATIVISTIC POTENTIAL SCATTERING. B.W.Lee.

Phys. Rev., Vol. 112, No. 6, 2122-4 (Dec. 15, 1958).

A new dispersion relation for nonrelativistic potential scattering, when the potential has a finite extent, is derived by completing the contours of integration along a semicircle of infinite radius in the lower half of the complex λ plane ($\mathrm{Re}\lambda = k$). The residue terms then explicitly exhibit the contributions from virtual states and radioactive decaying states. Resemblance between the residue term arising from a radioactive decaying state and the Breit–Wigner resonance formula is noted and the Breit–Wigner formula is shown to follow correctly from the analytic properties of the S matrix.

530.145

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530.145 : 530.162

4300. LOW-TEMPERATURE BEHAVIOR OF A DILUTE BOSE SYSTEM OF HARD SPHERES. I. EQUILIBRIUM PROPERTIES. T.D.Lee and C.N.Yang.
Phys. Rev., Vol. 112, No. 5, 1419-29 (Dec. 1, 1958).

By a generalization of the method used in a pervious paper (Abstr. 6893/1957) the distribution of energy levels of a dilute Bose system of hard spheres is found. These energy levels are then used to compute the statistical properties for the system. A phase transition is found, and the transition point is calculated to the lowest order of a, the diameter of the hard spheres. Furthermore, the thermodynamical functions of the system in both the gas phase and the degenerate phase are obtained, provided $(a/\lambda)\ll 1$ and $\rho a^3 \ll 1$, where λ is the thermal wavelength and ρ is the particle density.

530.145

4301. SIMPLIFIED TREATMENT FOR STRONG SHORT-RANGE REPULSIONS IN N-PARTICLE SYSTEMS. I. GENERAL THEORY. J.W.Clark and E.Feenberg.
Phys. Rev., Vol. 113, No. 2, 388-99 (Jan. 15, 1959).

A new variational approach is developed for studying the properties of systems of particles interacting through singular short-range repulsions that give rise to strong two-particle correlations. The correlated trial function $\Psi_\gamma = e^S\Phi_\gamma$ (state γ) results, with proper choice of S, in a simple form for the energy expectation value <H> — as well as for other matrix elements of interest — which is devoid of all reference to the strong repulsions except through e^{2S} factors and hence is particularly suited to calculation. In many cases an independent-particle type Φ_γ seems appropriate. The cluster evaluation of this form for <H> is discussed, both in the few-particle and many-particle cases. Using the techniques of Iwamoto and Yamada, simplified convergent cluster expansions for the energy expectation value are derived for many-fermion and many-boson systems. A programme for application of this method to nuclear problems is being initiated.

STATISTICAL MECHANICS
TRANSFER PROCESSES

530.162 : 539.12

4302. SOME PROBLEMS OF STATISTICAL ANALYSIS ARISING FROM THE PHYSICS OF MICROCORPUSCLES. I. POISSON DISTRIBUTIONS AND RELATIVE MEASUREMENTS. H.Breny.
Ann. Soc. Sci. Bruxelles I, Vol. 71, No. 3, 135-60 (1957). In French.

A detailed comparison of statistical methods applied to problems in microcorpuscular physics where the experimental data (e.g. particle counts, n_i, over time intervals given by T_i, $\Sigma T_i = 1$, $i = 1,\ldots N$) are mutually independent Poisson variates. The asymptotically equivalent methods of maximum likelihood, minimum χ^2 and modified minimum χ^2 are applied to the general problem of determining parameters θ_k (e.g. the half-life) from the expected values of the n_i. When n_i is a linear or an exponential function of θ the efficiencies of the above methods are compared with those of weighted and non-weighted least squares. The relative efficiency when the T_i are equal and when they compensate exactly for natural inequalities (e.g. of emissive powers) grows with N. When n_i is a hyperbolic function of θ the method of maximum likelihood reduces the number of unknowns by one, taking into account the relativity of the measurements, and compares satisfactorily with the iterative method sometimes used. G.A.Chisnall

530.162 : 539.1.07

4303. SOME PROBLEMS OF STATISTICAL ANALYSIS ARISING FROM THE PHYSICS OF MICROCORPUSCLES. II. A LITTLE STUDIED [RETROGRADE] ASPECT OF THE STOCHASTIC THEORY OF COUNTERS WITH DEAD TIME. H.Breny.
Ann. Soc. Sci. Bruxelles I, Vol. 72, No. 3, 81-96 (1958). In French.

A statistical picture of events before the commencement of a dead time in the theory of counters. The set of admissible configurations when traversing the time axis backwards is reconstructed with considerable generality and applied to a two-counter problem. The first counter has a given constant dead time τ and "detects" a particle at T_0 which is "registered" at T_1 by a second counter, a given distance D away and having zero dead time. $D/(T_1 - T_0)$ is usually used to estimate the velocity spectrum of the particles. Assuming that the distribution of times of arrival of incident particles at the first counter is a stationary Poisson process of intensity λ, the probability that the particle registered at T_1 was the same that was detected at T_0 is evaluated in terms of λ, τ, and a function depending on the velocity spectrum and the probability of absorption by the second counter; its lower limit is also given. G.A.Chisnal

530.162 : 533.72

4304. DIFFUSION FROM A POINT SOURCE INTO A SPACE BOUNDED BY AN IMPENETRABLE PLANE. H.A.Lauwerier.
App. sci. Res. A, Vol. 6, No. 2-3, 197-204 (1956).

Solutions for the concentration of particles in cylindrical space above a point source of constant intensity are obtained and examined in the light of experimental conditions and parameters that determine the concentration of particles of a metal evaporated between two electrodes. R.F.Pear

530.162 : 537.31

4305. GENERALIZED TRANSPORT THEORY. B.Block.
Ann. Phys. (New York), Vol. 6, No. 1, 37-49 (Jan., 1959).

Extension of some results derived by Lax (Abstr. 2650/1958) on the small coupling limit of transport theory. The present results extend the perturbation treatment for small external electric fields to magnetic fields in classical and quantum cases. The quantum results for Ohm's current and the Hall current are derived and compared with the classical results, and the conditions for classical limit to exist are examined. A quantum mechanical expression for the Hall coefficient is derived along with the usual expression for the conductivity tensor. This method could be extended to give similar results for magnetoresistance. The single particle approximation is used throughout.

530.162

4306. HYDRODYNAMICAL AND COLLECTIVE DESCRIPTION. K.Husimi and T.Nishiyama.
Fortschr. Phys., Vol. 6, No. 1-2, 16-29 (1958).

The paper reviews Bogolyubov's theory of the boson gas (Abstr. 2137/1947, 5898/1955) as well as Tomonaga's approach to collective motions in terms of collective coordinates (Abstr. 3324/1951, 6388-9/1956). The hydrodynamical approximations of these papers are compared with the collective description of Bohm and Pines. P.T.Landsberg

530.162

4307. A NOTE ON AN INFORMATION THEORETIC FORM OF THE UNCERTAINTY PRINCIPLE. R.Bourret.
Information and Control, Vol. 1, No. 4, 398-401 (Dec., 1958).

It is pointed out than an inequality due to Hirschman (1957) makes it possible to express the Heisenberg uncertainty principle in the form of an additive inequality in terms of entropy rather than as a multiplicative inequality in terms of deviations. Application of the new inequality to the spreading of a wave packet is described.

530.162

4308. THREE NEW PARTITION FUNCTIONS IN STATISTICAL MECHANICS. T.L.Hill.
J. chem. Phys., Vol. 29, No. 6, 1423-4 (Dec., 1958).

These all refer to systems with constant total energy and their logarithms give respectively H/kT, (TS-pV)/kT and E/kT. The first would be suitable for discussing a "grand microcanonical ensemble" with fixed E and V, but fluctuating N. J.Hawgood

530.162

4309. STATISTICAL MECHANICS OF COUPLED PARTICLES IN THE SCHRÖDINGER REPRESENTATION. R.H.Kraichnan.
Phys. Rev., Vol. 112, No. 4, 1056-7 (Nov. 15, 1958).

A perturbation treatment is presented for the operator u(t) giving the evolution of the state vector of a system of N particles coupled by 2-body forces. The total Hamiltonian is divided into a diagonal part H_0 and off-diagonal part H_1 in the representation with N-particle plane-wave states as basis. An effective pair-interaction operator $\bar{H}_1$ is defined which includes "vertex" corrections of all orders, and the off-diagonal part of u is expressed exactly by an expansion which involves only $\bar{H}_1$ and the exact diagonal part of u. A closed set of equations determining $\bar{H}_1$ and the diagonal part of u are obtained by retaining only the leading terms in the expansion. These equations include all the corrections included in the Brueckner approximation and, in addition, they contain 3-body effects, iterated to all orders, which are omitted in that approximation. No one-to-one correspondence between the eigenstates of H_0 and those of the total Hamiltonian is appealed to, and the ground state plays no special role. The connection with statistical mechanics follows the fact that the partition function is $\mathrm{Tr}[u(-i/kT)]$. The theory simplifies greatly for very large N.

530.162

4310. VARIATIONAL METHODS FOR SCATTERING PROBLEMS.

M.Kolsrud.

Phys. Rev., Vol. 112, No. 5, 1436-7 (Dec. 1, 1958).

Some new stationary expressions for the phase shifts and total amplitude by central force scattering are presented. As examples values of $\tan\delta_0$ are given for the exponential and Yukawa potential, and compared with the results by other methods and with the exact values.

530.162

4311. APPROACH OF ONE-DIMENSIONAL SYSTEMS TO EQUILIBRIUM. J.Ford.

Phys. Rev., Vol. 112, No. 5, 1445-51 (Dec. 1, 1958).

This paper defines an equilibrium coarse-grained probability density $F(X,P,\infty)$ in terms of the Liouville fine-grained density $f(X,P,t)$ through the equation

$$F(X,P,\infty) = \lim_{\Delta\Omega\to 0}\left(\frac{1}{\Delta\Omega}\right)\lim_{t\to\infty}\int_{\Delta\Omega} dXdPf(X,P,t),$$

and points out that $F(X,P,\infty)$ is the density which determines the observable properties of a system at equilibrium. Given a sufficiently smooth initial density $f_0(X_0,P_0,0)$, $F(X,P,\infty)$ is shown to exist and describe the equilibrium behaviour of two one-dimensional systems. This equilibrium behaviour is occasioned by the presence of non-linear forces. Because of the nonlinearity, the Poincaré recurrence time, for a given accuracy of return, depends on initial conditions. It is shown that this dependence causes a Gibbs-type stirring of phase space which leads to equilibrium.

530.162

4312. RIGOROUS VALIDITY CRITERION FOR TESTING APPROXIMATIONS TO THE ELECTRON GAS CORRELATION ENERGY. R.A.Ferrell.

Phys. Rev. Letters, Vol. 1, No. 12, 443-5 (Dec. 15, 1958).

The expression for the ground state energy per electron in a degenerate electron gas, as obtained by Gell-Mann and Brueckner, is claimed to be in error by at least 40% for densities of practical interest ($r_s \sim 3$). The argument is based on a theorem concerning the lowest eigenvalue of a Hermitian operator. P.T.Landsberg

530.162

4313. TECHNIQUE FOR MEASUREMENT OF CROSS-SPECTRAL DENSITY OF TWO RANDOM FUNCTIONS.

M.S.Uberoi and E.G.Gilbert.

Rev. sci. Instrum., Vol. 30, No. 3, 176-80 (March, 1959).

The cross-spectral density of two functions may be determined by using two selective filters which have identical impulse responses except for a relative phase difference which should be 0° and 90° for the measurement of cosine and sine components, respectively. A technique is developed which is quite accurate and requires a minimum of special equipment. The operation of the system is checked by measuring the cross-spectral density of two functions whose statistical properties are known.

530.162

4314. ON THE STATISTICAL APPROXIMATION OF THE MANY-BODY PROBLEM IN QUANTUM MECHANICS. K.Ladányi.

Z. Naturforsch., Vol. 13a, No. 4, 358 (April, 1958). In German.

A generalization of Macke's variational method (Abstr. 93, 938/1956) for the case of a spherically symmetric external potential is given. The method has been tested on the argon atom. P.Roman

530.162

4315. PROPERTIES OF THE GREEN'S FUNCTIONS OF PARTICLES IN STATISTICS. L.D.Landau.

Zh. eksper. teor. Fiz., Vol. 34, No. 1, 262-4 (1958). In Russian.

The Green's functions governing transitions between states of motion at different times is a concept of modern quantum electrodynamics which lends itself to application in the statistical mechanics of matter. An expression for this function is established which is appropriate to assemblies of non-interacting particles. A relation is obtained between the real and imaginary part of the Fourier transform of the Green's function. R.Eisenschitz

530.162

4316. ON THE QUANTUM-KINETIC EQUATION FOR SYSTEMS WITH SEVERAL TYPES OF CHARGED PARTICLES. S.V.Temko.

Zh. eksper. teor. Fiz., Vol. 34, No. 2, 523-4 (1958). In Russian. English summary: PB 141052T-1, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

A development of Bogolyubov's treatment of stochastic processes in many-particle systems. General and formal expressions are given which become tractable only when exchange and Coulomb interactions are assumed to be weak. An approximate expression for the screening coefficient is obtained for the case when all particles obey Fermi statistics. P.T.Landsberg

530.162

4317. THE METHOD OF APPROXIMATE SEPARATION OF VARIABLES AND ITS APPLICATION TO BOUNDARY VALUE PROBLEMS OF ELECTRODYNAMICS AND ACOUSTICS.

L.A.Vaĭnshteĭn.

Zh. tekh. Fiz., Vol. 27, No. 9, 2109-28 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 1955-73 (Sept., 1957).

This article presents an approximate method for solving two-dimensional boundary value problems in electrodynamics and acoustics, based on an approximate separation of variables in the wave equation written in conformal curvilinear coordinates. This method is analogous to the approximate Hartree—Fock method in quantum mechanics. The method is applied to a flat or rectangular waveguide which opens onto a horn and to surface waves propagating along a well-conducting wave-like ("corrugated") surface having the form of a cycloid or trochoid.

530.162 : 532.7

STATISTICAL-MECHANICAL THEORY OF TRANSPORT IN FLUIDS. See Abstr. 3203

530.162 : 530.145

LOW-TEMPERATURE BEHAVIOUR OF A DILUTE BOSE SYSTEM OF HARD SPHERES. EQUILIBRIUM PROPERTIES. See Abstr. 4300

530.162 : 532.7

QUANTUM THEORY OF SURFACE ENERGY AND TENSION. See Abstr. 4345

530.19

4318. CERTAIN TWO-DIMENSIONAL SOLUTIONS TO POISSON'S EQUATION. G.Power and H.L.W.Jackson.

Appl. sci. Res. B, Vol. 7, No. 4, 249-56 (1958).

The solution is subject to boundary conditions of sufficient generality to be applicable to many branches of mathematical physics. In the first instance, a circular boundary is considered, and by means of conformal transformation an indication is given showing how the solution can be adapted to other boundary shapes.

530.19

4319. THE PROBABILISTIC METHOD FOR PROBLEMS OF RADIATIVE TRANSFER. NON-COHERENT FORMATION OF AN ABSORPTION LINE IN THE MILNE—EDDINGTON MODEL.

S.Ueno.

C.R. Acad. Sci. (Paris), Vol. 246, No. 26, 3593-5 (June 30, 1958). In French.

See Abstr. 4771 (1958).

530.19

4320. THE PROBABILISTIC METHOD FOR PROBLEMS OF RADIATIVE TRANSFER. IV. MILNE'S PROBLEM WITH NON-COHERENT SCATTERING. S.Ueno.

Ann. Astrophys., Vol. 21, No. 1, 18-25 (1958).

See preceding abstract. Using the stochastic model of multiple scattering of photons, Milne's problem in a half-space, with non-coherent and isotropic scattering, is considered. Assuming that multiple scattering of the photons under consideration is a Markovian process, one derives the diffusion equation in the probability distribution of emission from the modified Chapman—Kolmogoroff equation. The emergent intensity is expressed in terms of the scattering operator defined by the probability distribution. The law of darkening for the non-coherent Milne's problem is established without actually solving the Milne first integral equation.

530.19

4321. ON THE THEORY OF RADIATION DIFFUSION.

I. GROWTH AND DECAY OF THE EXCITATION DENSITY.

R.Siewert.

Optik, Vol. 15, No. 12, 758-69 (Dec., 1958). In German.

A system of integro-differential equations is set up for individual excitation densities in a gas in which resonance radiation is diffusing. Solutions are obtained for arbitrary time dependence of the primary excitation and the form of the latter for exponential decay is investigated. W.T.Welford

530.19

4322. GENERAL RELATION BETWEEN FLUXES FROM COLLIMATED POINT AND PLANE SOURCES OF RADIATION. M.J.Berger and L.V.Spencer.
Phys. Rev., Vol. 113, No. 2, 408-12 (Jan. 15, 1959).

The radiation density (flux integrated over all directions) from a collimated point source is shown to be representable as a Fourier–Hankel transform of the density from a collimated plane oblique source. The spatial moments of a point-source density are similarly expressible as linear combinations of a finite number of moments of plane-source densities corresponding to different source obliquities. These results are valid for any type of radiation, provided that the medium is unbounded, homogeneous and isotropic, and provided that a linear transport equation applies. The plane-geometry representation of densities and density-moments is equivalent to a "separation of variables". It allows one to solve a sequence of problems in one space variable (distance from a source plane) for different values of the source obliquity, and to use the information thus obtained for constructing the solution of a problem involving two space variables (e.g. the longitudinal and radial distances from a point source).

GENERAL MECHANICS

MECHANICS OF SOLIDS

531.25 : 535.55

4323. STRESS OPTIC METHODS FOR THE INVESTIGATION OF DYNAMIC STATES OF STRESS. H.Schwieger.
Exper. Tech. der Phys., Vol. 4, No. 2, 70-80 (1956). In German.

The principle, experimental arrangement and the method of measurement are given. A transparent model is placed between crossed polarizers and the variations of light from the analyser, which occur in a short time, are registered by a photocell. A cathode ray oscillograph is used to record these variations and the optical path difference corresponding to every moment is determined by a procedure which is described. The maximum shear stress is found from the optical path difference and for a uniaxial state of stress the principal stress is calculated. In this way it is possible to obtain the behaviour over a period of time of the maximum shear stress and the principal stress for different kinds of models. Details of some experimental results are given. H.G.Jerrard

531.314.2

4324. ON A GENERALIZATION OF THE LAGRANGE FUNCTION. M.Borneas.
Amer. J. Phys., Vol. 27, No. 4, 265-7 (April, 1959).

Some mechanical aspects of a generalization with s-order derivatives of the Lagrange function are examined. The fundamental equations of a generalized Lagrangian mechanics are established.

531.4 : 537.221

RELATION OF CHARGE TO FRICTIONAL WORK IN THE STATIC ELECTRIFICATION OF FILAMENTS. See Abstr. 3416

531.55

4325. LOGARITHMIC SPIRAL: AN IDEAL TRAJECTORY FOR THE INTERPLANETARY VEHICLE WITH ENGINES OF LOW SUSTAINED THRUST. R.H.Bacon.
Amer. J. Phys., Vol. 27, No. 3, 164-5 (March, 1959).

It is shown that a vehicle with engines of low sustained thrust can be directed along a logarithmic spiral through an inverse-square gravitational field by means of an extremely simple guidance system; it is possible to choose a spiral for which initial and final velocities are optimum.

531.55 : 534.222.2

4326. GENERATION OF HIGH-VELOCITY PROJECTILES. M.A.Cook and R.T.Keyes.
J. appl. Phys., Vol. 29, No. 12, 1651-7 (Dec., 1958).

A technique of controlling the shape of detonation wave fronts in high explosives by inert wave control inserts was applied to generate discrete ultrahigh-velocity pellets. Tests to determine the most suitable pellet shape as well as the optimum charge configuration are described, and velocities up to 7600 m/s were realized for 0.95-g aluminium pellets. The mechanism whereby pellets are accelerated by "shaped" waves is discussed, and the conclusion is reached that a simple model based upon the transmission of shock from the detonation wave to the pellet is not applicable.

MECHANICAL MEASUREMENTS

531.714

4327. MEASURING DEVICE FOR DIFFRACTION PATTERNS. M.J.Columbe.
Rec. sci. Instrum., Vol. 30, No. 3, 181-2 (March, 1959).

A device for accurate measurement of diffraction patterns is described in detail. The accuracy of measurement is better than 0.01%. In addition, this device is useful for viewing photographic negatives and can also be used for other kinds of measurements.

531.715 : 535.417

NEW GAUGE INTERFEROMETER. See Abstr. 3347

531.715 : 535.417

PRECISION OF MICROINTERFEROMETRY INVESTIGATIONS CONCERNING INTERFERENCE SPHEROMETRY. See Abstr. 3350

531.715.2

4328. A NEW INSTRUMENT FOR MEASURING THE THICKNESS OF GLASS TUBE WALLS. K.Bernolàk.
Exper. Tech. der Phys., Vol. 1, No. 2, 91-2 (1953). In German.

A simple optical device is described whereby the direct measurement of the thickness of glass tube walls may be made to an accuracy of 0.01 mm; the latter depends on the regularity of the tube thickness. H.H.Hodgson

531.715.2

4329. MIRROR MICROMETERS. N.Bárány.
Periodica polytech., Elect. Engng, Vol. 2, No. 3, 205-27 (1958).

Some of the known micrometers for measuring small angles and short distances are described above. An attempt was made to replace the 200 years old Boscovich rotating pair of wedges by a mirror micrometer. In the new instrument a mirror micrometer is used as a penta mirror, thus associating the penta mirror with the rotating pair of wedges. Its accuracy depends on two factors: the mode of drive on one hand, the deformation of the mirror mounting owing to changes of temperature on the other. As regards the mode of drive, a gear mechanism can only be applied on a laboratory scale, as it does not give a satisfactory accuracy in the transmission of angles. Therefore, one has to apply other modes of drive. Temperature influences can be felt by the mirror mounting, generally used for penta mirrors too. It is therefore essential to provide for heat insulation, and to resort to the most careful methods of manufacture.

531.717.1 : 621.315.59

4330. A GAUGE FOR THE PRECISION MEASUREMENT OF THE THICKNESS OF GERMANIUM AND SILICON WAFERS. D.Baker.
Proc. Instn Elect. Engrs, Paper 2891E [International Convention on Transistors and Associated Semiconductor Devices], publ. May, 1959, 3 pp. To be republished in Vol. 106B (1959).

Some of the difficulties associated with the precision measurement of the thickness of thin germanium and silicon wafers, together with several possible methods of measurement, are briefly discussed. A gauge which employs the optical-lever principle is described in which frictional restraint of the moving parts is reduced to that of a knife edge alone, thus ensuring good repeatability of reading with probe pressures of less than 3 g. The gauge covers the range 0-270 microns with an overall accuracy of ±0.5 micron.

531.717.3 : 538.566 : 621.385.63 : 621.317.39

4331. AUTOMATIC MEASUREMENT OF SMALL DEVIATIONS IN PERIODIC STRUCTURES.
H.T.Closson, W.E.Danielson and R.J.Nielsen.
Rev. sci. Instrum., Vol. 29, No. 10, 855-9 (Oct., 1958).

Special optical, mechanical, and electronic techniques have been combined in a new instrument, the microdeviometer — originally developed for measuring and recording the pitch uniformity of helices in travelling wave tubes — in which a beam of light and two optical gratings are used to obtain a very accurate scale of distance. The location, with respect to this distance scale, of the salient periodic features in the structure being measured is established through the interception of a second light beam by the structure. Electronic circuitry automatically stores and processes the position information and feeds the processed information, in the form of deviations from the corresponding ideal structure, to a pen recorder. A measuring accuracy of $\pm 1\ \mu$ has been consistently obtained, and measurements which formerly required nearly 2 man-days are accomplished in less than 10 min.

531.752

4332. AUTOMATIC RECORDING VACUUM MICROBALANCE.

C.N.Cochran.

Rev. sci. Instrum., Vol. 29, No. 12, 1135-8 (Dec., 1958).

An automatic control and recording system for the null-type vacuum microbalance of Czanderna and Honig (Anal. Chem 29, 1206, 1957) was assembled from commercial components. A variable permeance transducer is employed to detect beam movement and to control a force to restore the beam to the null position. This force is recorded in a selection of ranges extending from 0-20 000 μg to 0-5 μg with accuracies ranging from 0.1% to 2% of full scale. On the most sensitive settings the balance can detect weight changes as small as 0.01 μg in loads up to 1 g. Stabilities of 0.1 μg were observed for periods of many hours on the most sensitive ranges. The balance is undamped, and no corrections are made to the restoring force if beam oscillation is centred about the null point.

MECHANICS OF FLUIDS

532.133

4333. A METHOD FOR MEASURING THE DYNAMIC VISCOSITY AND DYNAMIC RIGIDITY OF VISCO-ELASTIC LIQUIDS. I.

Ali Abdel Kerim Ibrahim.

J. Phys. Soc. Japan, Vol. 13, No. 3, 313 (March, 1958).

A "dynamic viscosity" and a "dynamic rigidity" are calculated as functions of the frequency from published observations on polymer solutions oscillated in a coaxial-cylinder elastoviscometer.

J.G.Oldroyd

532.133

4334. VISCOSITY—TEMPERATURE RELATIONSHIPS FOR DILUTE SOLUTIONS OF CELLULOSE DERIVATIVES.

I. TEMPERATURE DEPENDENCE OF SOLUTION VISCOSITIES OF ETHYL CELLULOSE.

W.R.Moore and A.M.Brown.

J. Colloid Sci., Vol. 14, No. 1, 1-12 (Feb., 1959).

Viscosities of dilute solutions of six fractions of ethyl cellulose, molecular weight range 40 000-140 000, in six solvents were determined at different temperatures between 25° and 60°C. Log η is very approximately a linear function of the reciprocal of the absolute temperature T. Values of Q and A in the expression $\eta = Ae^{Q/RT}$ are obtained. The apparent activation energy of viscous flow, Q, is linearly related to concentration c and molecular weight M by

$$Q = Q_0 + K_e Mc$$

and

$$A = A_0 e^{-K_a M^{\alpha} c},$$

where Q_0 and A_0 are values for the pure solvents and K_e, K_a, and α are constants for a particular ethyl cellulose—solvent system. The values of K_a and α may vary slightly with M. An expression is derived giving the intrinsic viscosity in terms of K_e, K_a, α, M, and T.

532.137

4335. MODIFICATION OF A CONE-PLATE VISCOMETER FOR DIRECT RECORDING OF FLOW CURVES.

W.H.Bauer, A.P.Finkelstein, C.A.Larom and S.E.Wiberley.

Rec. sci. Instrum., Vol. 30, No. 3, 167-9 (March, 1959).

Using a concentric-cylinder rotational viscometer, Weltmann showed that automatic recording of flow curves in accordance with a predetermined programme is important in the study of materials whose flow properties are shear-dependent and time-dependent. When the flow of such materials as greases was studied using the Ferranti—Shirley cone-plate viscometer, advantages of small sample size, ease of loading with minimum deformation, and uniform shear rate across the sample were apparent. However, time-dependent properties of the grease could not be adequately described from data obtained in manual operation of the cone-plate viscometer. An automatic control device for shear rate acceleration of the cone-plate viscometer was designed so that flow curves can be obtained automatically using an X—Y recorder. Flow curves of typical greases and other materials exhibiting non-Newtonian and time dependent properties were successfully obtained using this automatic control device. The cone-plate viscometer as modified has distinct advantages for the study of non-Newtonian and time-dependent materials.

532.5 : 537.228

4336. ON THE MECHANICAL MOMENT OF ROTATION OF MIXTURES OF LIQUIDS IN ROTATING ELECTRIC FIELDS.

A.Carrelli and M.Marinaro.

Nuovo Cimento, Vol. 11, No. 2, 262-8 (Jan. 16, 1959).

The behaviour of some mixtures of liquids in rotating electric fields at low frequencies was studied. It was found that the mechanical moment produced, even taking into account the electric conductivity variation, is about 10^3 greater than that predicted by Lampa's theory (1906).

532.5 : 536.25 : 538.3

THERMAL INSTABILITY OF INTERNALLY HEATED FLUID SPHERE IN MAGNETIC FIELD. See Abstr. 3658-60

532.517.4 : 533.6.013.22

4337. A THEORY OF HOMOGENEOUS ISOTROPIC TURBULENCE.

P.C.Jain.

Appl. sci. Res. A, Vol. 8, No. 2-3, 219-27 (1959).

An attempt is made to find a simplifying hypothesis for connecting the higher order correlation tensor with the lower ones. Starting from the Navier—Stokes equations of motion for an incompressible fluid and following the usual method of taking the averages, a differential equation is derived in Q and X, the defining scalar of the second order correlation tensor Q_{ij} and the defining scalar of a third order isotropic tensor X_{ijk}. The tensor X_{ijk} stands for a tensorial expression containing the derivatives of the third and the fourth order tensors. Then the hypothesis is used that X = F(Q), where F is an unknown function. To find the forms of F, Kolmogoroff's similarity principles are used, and thus two forms for F(Q) corresponding to two regions of the validity of these principles are deduced.

532.529

4338. SPRAY COMBUSTION AND ATOMIZATION. F.A.Williams.

Phys. of Fluids, Vol. 1, No. 6, 541-5 (Nov.-Dec., 1958).

A statistical formalism for describing the behavior of sprays is presented, which includes the effects of droplet growth, the formation of new droplets, collisions, and aerodynamic forces. Criteria for the efficiency of impinging jet atomization are developed. It is shown that if the incident jets have a size distribution of a generalized Rosin—Rammler type, then the resulting spray belongs to the same class of distributions. The size history of evaporating sprays is also obtained from the theory. A spray combustion analysis given by Probert is extended to include more general size distributions and the effects of droplet interactions and the relative motion of the droplets and the fluid. It is shown that the over-all spray evaporation rate is largest for uniform sprays.

532.582.3

4339. WAVE FORCES ON GROUPS OF VERTICAL CYLINDERS.

J.E.Chappelear.

J. geophys. Res., Vol. 64, No. 2, 199-208 (Feb., 1959).

A method is presented for the calculation of wave forces on groups of circular cylinders. The assumptions employed are that (1) wave forces are produced by a localized nonlinear phenomenon, for example, a detached boundary layer, and the velocity distribution around the pilings is that given by potential flow; (2) the centre-to-centre distances of the various cylinders are small compared with the wavelength (Airy theory); (3) the radii are small compared with the centre-to-centre distances; (4) the wave force on one cylinder is known empirically. Then a calculation of the laminar velocity field around the cylinders can be made. The result obtained is that only the magnitude of the velocity distribution and the location of the stagnation points are changed, not the details of the angular dependence. The angular dependence is the same as is calculated on one cylinder. Then, arguing that similar causes produce similar effects, one can calculate geometrical correction factors to the drag and inertial coefficients for a single cylinder. Certain examples involving a small number of cylinders in simple geometrical arrays are presented to illustrate the application of the method, and a brief discussion of the experimental evidence is given.

532.584

4340. PARTICLE MOTIONS IN SHEARED SUSPENSIONS.

VIII. SINGLETS AND DOUBLETS OF FLUID SPHERES.

W.Bartok and S.G.Mason.

J. Colloid Sci., Vol. 14, No. 1, 13-26 (Feb., 1959).

For Pt VII see J. Colloid Sci., Vol. 13, No. 4, 293-27 (Aug., 1958).

532.61.08

4341. THERMAL PRESSURE FLUCTUATIONS IN A GAS AS NATURAL LIMIT FOR THE MEASUREMENT OF SURFACE TENSION BY THE BUBBLE PRESSURE METHOD. G.Passoth.

Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 1-2, 13-22 (1958).
In German.

This was established in an apparatus developed for the measurement of the relative surface tensions of solutions. Two connected capillary tubes of different bore diameter dip in the solution, the difference of immersion depth of both being variable, and are so set that the pressures required to release bubbles from each capillary tip are equal. It is then found that the gas bubbles are released with a statistical distribution as soon from the one as from the other capillary.
W.Good

532.613.5 : 532.7

EQUATION OF STATE AND SURFACE TENSION OF LIQUIDS. See Abstr. 3200

532.62 : 534.321.9

4342. ULTRASONIC ATOMIZATION OF LIQUIDS.

J.N.Antonevich.
I.R.E. Trans Ultrasonics Engng, No. PGUE-7, 6-15 (Feb., 1959).

Observations of liquid films excited ultrasonically are described and discussed. These films atomized under ultrasonic excitation, and the rupture of capillary waves in the film is suggested as the prime cause of atomization. The atomization of a paint film by 20 kc/s vibrations was studied qualitatively. High-speed motion pictures show sprays emanating from vibrating gas bubbles in the paint film. The particles produced were from 5 to 500 μ in diameter. Under the best atomizing conditions at 20 k/cs the particle diameters were from 20 to 70 μ.

MOLECULAR THEORY OF LIQUIDS

532.7

4343. THEORY OF ORIENTATIONAL EFFECTS AND RELATED PHENOMENA IN DIELECTRIC LIQUIDS. A.Piekara and S.Kielich.

J. chem. Phys., Vol. 29, No. 6, 1297-305 (Dec., 1958).

Formulae are developed for the molar constants of five non-linear effects of molecular orientation in liquids; namely, the dielectric saturation in electric, magnetic, or optical fields and the electric as well as the magnetic birefringence. No assumption is made concerning the nature of the intermolecular forces, and no special model of molecular interaction is introduced. If the molecules may be considered to possess axial symmetry, four correlation factors R_P, R_{CM}, R_K and R_S can be derived. These factors appear in the formulae of the molar constants of the Cotton—Mouton and Kerr effects, and of the effect of dielectric saturation in an electric, magnetic, or optical field. The correlation factors have been calculated as functions of $\theta^{(pq)}$, the angle between the axes of symmetry of the p-th and q-th molecules, in the absence of a biasing field. The theory makes it possible to predict the value of the magnetodielectric saturation effect in diamagnetic liquids, as well as the photodielectric saturation, relating these phenomena to magnetic or electric birefringence. Moreover, the meaning of this theory consists in the fact that it gives a quantitative explanation of the inverse saturation effect appearing in some polar liquids and increasing their dielectric constant. Satisfactory results have been obtained by applying this theory to such phenomena as light scattering in liquids or the lowering of the freezing point, in which the orientationally dependent intermolecular forces play an important part.

532.7 : 538.69 : 538.27

4344. NUCLEAR RELAXATION IN LIQUIDS AT VARIOUS TEMPERATURES. L.Giulotto, G.Lanzi and L.Tosca.

Nuovo Cimento Suppl., Vol. 9, No. 2, 398-401 (1958). In Italian.

The proton relaxation time T_1 was measured in water between the temperatures of -10 and +90°C, and in ethyl alcohol between 25 and 70°C. For the apparatus employed see Abstr. 390 (1955). According to existing theories based on the Debye model, the quantity $T_1\eta/T$ (η = coefficient of viscosity; T = absolute temperature) should be independent of T; deviations were found from this law, an indication that definite molecular associations do not exist in these liquids.
L.Pincherle

532.7 : 530.16

4345. QUANTUM THEORY OF SURFACE ENERGY AND TENSIO

R.Brout and M.Nauenberg.
Phys. Rev., Vol. 112, No. 5, 1451-5 (Dec. 1, 1958).

The surface energy E_S of a system of interacting particles is $E_S = \int_{-\infty}^{\infty} dz\{\epsilon(z) - \epsilon_B[\rho(z)/\rho_B]\}$, where $\epsilon(z)$ and $\rho(z)$ are the energy and particle densities along the axis normal to the surface, ϵ_B and ρ_B are the corresponding quantities in the bulk. Alternatively, one may formulate an exact expression for the surface tension defined as $\gamma = (\partial F/\partial S)_V$, with the result that

$$\gamma = \int_{-\infty}^{\infty} dz \left\{2[t_z(z) - t_\perp(z)] + \frac{1}{4}\int dr(r^2 - 3r_z^2)\frac{1}{r}\frac{dv}{dr}\rho^{(2)}(z, z + r_z)\right\}.$$

$t_i(z)$ are the components of the average kinetic energy density and $\rho^{(2)}(r_1,r_2)$ is the pair distribution function. In the ground state $\gamma = E_S$. These formulae were applied to liquid He^4 and He^3 assuming that $\rho^{(2)} = \rho(z) \times \rho(z + r_z)g_B(r)$. The bulk radial distribution $g_B(r)$ is obtained from X-ray data. Use of the thermodynamic data ϵ_B and $p = 0$ gives t_B and checks $g_B(r)$. Further, a free-volume form is assumed of the kinetic energy density $t(z) = t_B[\rho(z)/\rho_B]^{5/3}$ and an exponential density fall-off $\rho(z) = \rho_B e^{-z/a}$. Calculated values of E_S show a minimum at a = 2.0 A. E_S and γ differ by 20% at this value, with γ being 0.38 erg/cm^2 for He^4. The experimental value of γ is 0.35 erg/cm^2.

532.7 : 534.22

PROPAGATION OF SOUND IN LIQUID METALS. HOLE THEORY. See Abstr. 3224

532.74 : 548.74

4346. ATOMIC DISTRIBUTION IN LIQUID AND SOLID NEON AND SOLID ARGON BY NEUTRON DIFFRACTION. D.G.Henshaw.

Phys. Rev., Vol. 111, No. 6, 1470-5 (Sept. 15, 1958).

The angular distribution of 1.06_4 A neutrons scattered from liquid neon at 26.0 ± 1.5°K and 1.7 atmospheres and that from solid neon and solid argon at 4.2°K were measured over the angular range 5° to 64°. The transmission cross-section of liquid neon was also measured and is 2.7 ± 0.3 barns for 1.06_4 A neutrons. The scattering pattern and corresponding distribution function $4\pi r^2[\rho(r) - \rho_0]$ for liquid neon are similar in form to those of other measured inert gases. A study of the distribution function gives 2.45 A, 3.17 A and 8.8 for the nearest distance of approach of two atoms, the most probable separation of, and the number of neighbours under, the first shell of atoms, respectively. It is concluded that the effective potential in the liquid has a broader bowl than that of the Lennard-Jones 12:6 and other similar potentials. The lattice parameters a_0 for the f.c.c. structures of solid neon and solid argon are 4.42_9 A and 5.25_6 A, respectively. The Debye temperature for solid neon corresponding to the intensity of the diffraction maxima is 73°K. The results suggest that the density change during the solid—liquid transformation cannot be accounted for by either a uniform depletion of atoms from, or a uniform dilation of, a basic structure.

532.77 : 532.13

4347. VISCOELASTIC PROPERTIES OF CONCENTRATED SOLUTIONS OF POLYVINYL ALCOHOL.

S.Onogi, I.Hamana and H.Hirai.
J. appl. Phys., Vol. 29, No. 10, 1503-10 (Oct., 1958).

The dynamic viscosity and rigidity of concentrated solutions of polyvinyl alcohol samples having different molecular weights were measured by means of a torsionally oscillating rheometer and an electromagnetic transducer within the ranges of frequencies from 0.08 to 400 c/s and the temperature range from 20° to 55°C. The solutions behave almost as Newtonian liquids at lower frequencies; however, at the frequencies around 1 to 10 c/s the viscosity of solutions begins to decrease while the rigidity increases rapidly. The frequency at which the rather abrupt change in dynamic viscosity and rigidity takes place is lower the higher the concentration, the higher the molecular weight, and the lower the temperature. The effects of the concentration, temperature, and molecular weight on the zero shear (frequency) viscosity have been examined quantitatively, and some of characteristic features observed on other high polymers have also been found. Comparison of the dynamic viscosity with the steady-flow viscosity shows that the frequency dependence of dynamic viscosity is not quite quantitatively equivalent to the rate of shear dependence of steady-flow viscosity. The dynamic data have also been compared with two molecular theories of viscoelastic behaviour of high polymers, and showed rather good agreement. A slight discrepancy observed in this comparison may be attributed to the molecular weight distribution in the sample and intermolecular interlacings in the concentrated solution.

532.783

4348. ON THE THEORY OF LIQUID CRYSTALS. F.C.Frank.
Disc. Faraday Soc., No. 25, 19-28 (1958).

A general theory of curvature-elasticity in the molecularly uniaxial liquid crystals, similar to that of Oseen, is established on a revised basis. There are certain significant differences: in particular, one of Oseen's coefficients is shown to be zero in the classical liquid crystals. Another, which Oseen did not recognize, does not interfere with the determination of the three principal coefficients. The way is therefore open for exact experimental determination of these coefficients, giving unusually direct information regarding the mutual orienting effect of molecules.

532.783

4349. A SIMPLE MOLECULAR THEORY OF THE NEMATIC LIQUID CRYSTAL STATE. W.Maier and A.Saupe.
Z. Naturforsch., Vol. 13a, No. 7, 564-6 (July, 1958). In German.

The nematic liquid crystal state is ascribed to the degree of parallelism S of the elongated molecules concerned. S is defined as $(1 - \frac{3}{2}\sin^2\theta)$, $\sin^2\theta$ being the mean square of the sine of the angle between molecular and crystal axes. The p.e. of a particular molecule (1) can be denoted by $D_1(\theta_1, \sin^2\theta, V)$, where V is the molecular volume. D_1 is found to be $-A/V^2(1 - \frac{3}{2}\sin^2\theta_1)(1 - \frac{3}{2}\sin^2\theta)$, where A is a characteristic of the substance. The energy function is plotted for different values of $AT^{-1}V^{-2}$. The theory describes the degree of ordering of 4,4'-dimethoxy-azoxybenzene within the limits of experimental error. A.L.Mackay

MECHANICS OF GASES
VACUUM TECHNIQUE

533.15

4350. MOLECULAR DIFFUSION STUDIES IN GASES AT HIGH TEMPERATURE. I. THE "POINT SOURCE" TECHNIQUE.
R.E.Walker and A.A.Westenberg.
J. chem. Phys., Vol. 29, No. 5, 1139-46 (Nov., 1958).

A new method of measuring the diffusion coefficients of gases makes use of the steady injection of a trace gas from a fine, hypodermic tube (essentially a "point source") into a slow, uniform, laminar stream of a second (carrier) gas. Measurements of the trace gas concentration downstream of the source by means of precise gas sampling permit the binary diffusion coefficient to be determined. By heating the carrier gas the measurements may be extended to fairly high temperatures. Another advantage offered by the method is that the trace gas concentrations involved are essentially zero, so that uncertainties regarding the concentration dependence of the diffusion coefficient are avoided. Results of about ±1% precision over the temperature range 300-1150°K are presented for the systems $He-N_2$ and CO_2-N_2.

533.15

4351. MOLECULAR DIFFUSION STUDIES IN GASES AT HIGH TEMPERATURE. II. INTERPRETATION OF RESULTS ON THE $He-N_2$ AND CO_2-N_2 SYSTEMS. R.E.Walker and A.A.Westenberg.
J. chem. Phys., Vol. 29, No. 5, 1147-53 (Nov., 1958).

Experimental data on the binary diffusion coefficients of $He-N_2$ and CO_2-N_2 obtained by the "point source" technique over the temperature range 300-1150°K (see preceding abstract) are discussed in terms of intermolecular potential energies. For $He-N_2$, the data can be satisfactorily represented by a purely repulsive potential. The data include the extremes of the concentration dependence for D_{He-N_2}, i.e., with either He or N_2 present only as a trace component, and this effect is taken into account in the theoretical interpretation. It is shown that, at their upper temperature limit, the data come within 150° of overlapping the range of validity for the diffusion coefficient predicted from the repulsive potential obtained by Amdur et al. from molecular scattering experiments. A slight interpolation indicates quite remarkable agreement between the two types of experiments. This is good evidence of the validity of predicting high-temperature transport properties from scattering potentials in certain cases — a possibility first pointed out by Amdur. A modified Buckingham (exp-six) potential is also obtained which covers both the diffusion and scattering potentials. For CO_2-N_2, the data are fitted with a Lennard-Jones (6-12) potential. It is shown that (for both $He-N_2$ and CO_2-N_2) the predictions derived from viscosity parameters for the pure components and simple combining rules are quite unreliable at high temperatures.

533.15

4352. THEORY OF THE FLOW OF A GAS IN A POROUS MATERIAL IN THE NEAR-KNUDSEN REGION.
B.V.Deryagin and S.P.Bakanov.
Zh. tekh. Fiz., Vol. 27, No. 9, 2056-70 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 1904-18 (Sept., 1957).

The replacement of an actual porous material by a model composed of spheres distributed randomly in space makes it possible to apply the Chapman--Enskog method to the flow of a gas through a porous medium. The filtration coefficient of a gas has been obtained as a function of the pressure. It is shown that the curve of this function passes through a minimum. This result makes it possible to explain the course of the curve of amount of gas passing through as a function of the pressure in the experiments of Knudsen, Gaede and others with capillaries of various cross-sections. The results are of especial importance for highly porous materials.

533.16

4353. DIFFUSIVE SLIP AND CONVECTIVE DIFFUSION OF A GAS IN A CAPILLARY. R.Ya.Kucherov.
Zh. tekh. Fiz., Vol. 27, No. 9, 2158-61 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 2001-4 (Sept., 1957).

The phenomenon of slip takes place on the boundary between a moving gas and the surface of a solid. In describing this process it is usual to consider effects related to those components of the pressure and temperature gradients which are tangent to the surface. The present note considers diffusive slip, i.e. slip related to the component of the concentration gradient which is tangent to the surface, and the influence of this phenomenon on convective diffusion of gases in capillaries. The derivation of the equation for the slip velocity is a generalization of an elementary derivation of this equation to the case of an isothermal mixture of gases with nonhomogeneous concentration.

533.5 : 531.788

4354. ON THE DETERMINATION OF THE ORDER OF MAGNITUDE OF THE PRESSURE BEHAVIOUR IN HIGH VACUUM EQUIPMENT WITH THE HELP OF FLUORESCENT RADIATION.
A.Burger.
Exper. Tech. der Phys., Vol. 2, No. 1, 38-9 (Jan., 1954). In German.

Describes an arrangement in which the pattern of radiation produced from a fluorescent screen as a result of a h.f. discharge may be used to indicate the pressure (10^{-1} to 10^{-5} mm Hg) in a system. J.Dutton

533.56

4355. THE HEATING OF DIFFUSION PUMPS.
J.Amoignon, G.Mongodin and J.Moreau.
Vide, Vol. 13, 204-7 (July-Aug., 1958). In French.

Describes the present heating systems in use on oil diffusion pumps and discusses their relative advantages and disadvantages. A new form of heater is described, which is readily demountable, and, it is claimed, gives a better heat distribution. R.D.Hudson

533.59

4356. APPARATUS FOR THE CONTINUOUS INTRODUCTION OF CONSTANT AMOUNTS OF GAS INTO A VACUUM SYSTEM.
H.Schmellenmeier.
Exper. Tech. der Phys., Vol. 2, No. 1, 27-30 (Jan., 1954). In German.

Describes the construction and method of operation of an apparatus for this purpose, using a porous glass filter valve with a mercury cut-off. J.Dutton

533.59

4357. GAS EVOLUTION FROM MATERIALS IN VACUUM.
R.Jaeckel and F.J.Schittko.
Forschungsber. Wirtsch.-Verkehrsmin. Nordrhein-Westfalen, No. 369, 35 pp. (1957). In German.

Describes an extensive experimental study of the outgassing of synthetic materials and metals in high vacuum. The apparatus, including a mass-spectrometer for identifying the gases evolved, is described and tabular results are presented. Among the synthetics, polyethylene, Teflon and silicone rubber all gave low and roughly equal final pressures. A material called "Hostaflon" made by Farbwerke Hoechst was outstandingly good. However, no results on the effects of temperature, during the outgassing, are given, although preliminary baking was sometimes used. A.H.W.Beck

533.59 : 539.17 : 621.039 : 621.387

4358. VACUUM SYSTEM DESIGN [IN ZETA I]. J.Blears and E.J.Greer.
Proc. Instn Elect. Engrs, Paper 2904 [Convention on Thermonuclear Processes], publ. March, 1959, 6 pp. To be republished in Vol. 106A (1959).

The Zeta I vacuum system consists of a toroidal tube of 42 in. bore by 11 ft mean diameter fabricated from 1 in. aluminium plate with a 48-section insulated interleaved water-cooled liner made from $\frac{1}{8}$ in. aluminium sheet. The torus was split vertically, each half torus being mounted on a trolley with its vacuum pumps and ancillaries, and arranged in such a way that the whole system could easily be withdrawn from the transformer core for servicing or modification. Experimental work in 1957 and 1958 was not seriously limited by vacuum techniques, since loss due to radiation from impurities in the discharge appears to have been only about 20% of the energy input, but it is unlikely that a significant increase in temperature will be attained unless impurities in the discharge can be reduced by one or two orders of magnitude.

533.6.013.22 : 532.517.4

HOMOGENEOUS ISOTROPIC TURBULENCE. See Abstr. 4337

533.6.011

4359. FLOW FIELD OF A FLAME IN A CHANNEL. S. Uberoi.
Phys. of Fluids, Vol. 2, No. 1, 72-8 (Jan.-Feb., 1959).

A stationary flame is stabilized in a two-dimensional channel in such a way that it closely corresponds to the case of a flame propagating in a channel. The entire flow field of unburned and burned gases is mapped by taming stroboscopic photographs of small particles suspended in the combustible gases. The asymptotic flow field of the burned gases is analysed in terms of flow conditions at the flame. The possibility of obtaining an analytic flow field on the basis of constant flame speed is examined. It appears that no solution exists unless the channel walls in the region of burned gases are displayed inward. This investigation, together with the previous work on the flow field of a Bunsen flame, leads to some general remarks about the structure and stability of laminar flames. The various predictions are in agreement with experiments. In particular, the convex flames are possible and concave ones impossible within the framework of the theory based on constant flame speed.

533.6.011.5

4360. THE FREE MOLECULE PROBE AND ITS USE FOR THE STUDY OF LEADING EDGE FLOWS. J.A.Laurmann.
Phys. of Fluids, Vol. 1, No. 6, 469-77 (Nov.-Dec., 1958).

The development of a free molecule probe for use as an instrument in the investigation of two dimensional rarefied gas flow fields is described. The probe consists of a cross-stream cylindrical wire of diameter small compared with the mean free path of the gas. Measurement of the probe temperature and heat transfer characteristics yields information that can be related theoretically to the state of the flowing gas. This paper describes the use of such information in the study of the qualitative nature of supersonic flow about sharp leading edges in regions where rarefaction, slip, and boundary layer—shock wave interaction effects are important. The results showed clearly the effect of increasing density. Thus, at the lowest densities and Mach numbers, a clearly defined shock wave and boundary layer emerged from a region of mixed compressive and viscous action at the leading edge, while at the higher densities and Mach numbers there was a large region of strong boundary layer—shock wave interaction and a considerable delay in the formation of clearly defined shock wave.

MOLECULAR THEORY OF GASES

533.7

4361. MOLECULAR MODELS: EXPRESSIONS OF THE TRANSPORT AND VIRIAL COEFFICIENTS. J.A.McMillan.
Amer. J. Phys., Vol. 27, No. 3, 151-60 (March, 1959).

A review of the transport and the virial coefficients from the point of view of their expressions as derived from rigid sphere, Sutherland, inverse power, and Lennard-Jones models, is given. The assignment of the interaction behaviour from viscosity data is discussed.

533

4362. CALCULATION OF THE EIGENVALUES OF THE ELASTI COLLISION OPERATOR OF A LORENTZ GAS. STUDY OF SOME COMMON CASES.
A.Arsac, L.Basquin, J.F.Denisse, J.L.Delcroix and J.Salmon.
J. Phys. Radium, Vol. 19, No. 7, 624-9 (July, 1958). In French.

The calculation is given for different types of interaction. In particular, the numerical processes are developed which permitted these eigenvalues to be obtained.

533.

4363. TRANSPORT COEFFICIENTS DETERMINED USING THE SHIELDED COULOMB POTENTIAL. R.L.Liboff.
Phys. of Fluids, Vol. 2, No. 1, 40-6 (Jan.-Feb., 1959).

In the classical Chapman—Enskog theory of a fully ionized gas the transport coefficients evolve as functionals of certain weighted total scattering cross-sections. If a Coulomb potential is assumed between scattering particles, these scattering integrals diverge. A common procedure to circumvent this difficulty is to integrate the Coulomb results up to the Debye cutoff. A more appropriate procedure involves the use of the shielded Coulomb potential, in which case the scattering integrals converge, and there is no need to introduce a cutoff. These integrals are calculated using the shielded Coulomb potential and the resultant transport coefficients are compared with those of the standard "Coulomb plus Debye cutoff" calculations. To the "dominant log term" the two procedures give identical results. To terms of the next order of accuracy for the viscosi and thermal conductivity the difference between the two formulation is of the order of 0.5%, and for the diffusion and electrical conductivity, the difference is of the order of 2%. The major calculation is that of the classical cross-section for the screened Coulomb potential.

533.7

4364. A NOTE ON THE VARIATION PRINCIPLE IN THE KINETIC THEORY OF GASES. S.Ono.
Sci. Pap. Coll. Gen. Educ. Univ. Tokyo, Vol. 5, No. 2, 87-96 (Dec., 1955).

The Boltzmann equation for dilute gases is considered. The first approximation to the solutions have previously been obtained by the use of variational principles. In this paper, the physical significance of this principle, and of the subsidiary conditions which have to be satisfied, are investigated. P.T.Landsberg

533.72 : 530.162

DIFFUSION FROM A POINT SOURCE INTO A SPACE BOUNDED BY AN IMPENETRABLE PLANE. See Abstr. 4304

VIBRATIONS . ACOUSTICS

534.121.1

4365. FLEXURAL VIBRATION OF THIN LAMINATED PLATES. K.S.Pister.
J. Acoust. Soc. Amer., Vol. 31, No. 2, 233-4 (Feb., 1959).

A procedure is described for calculating the frequencies of free vibration of plates composed of bonded, thin elastic laminae. The problem is reduced to the calculation of composite elastic parameter and the transposition of results from corresponding single-layer plat problems. The vibration is assumed to be governed by the Poisson—Kirchhoff theory of flexure, omitting the effects of transverse shear deformation and rotary inertia.

534.133 : 537.228.1

4366. EQUATIONS OF MOTION FOR DAMPED LONGITUDINAL, TORSIONAL AND FLEXURAL OSCILLATIONS OF PIEZOELECTRIC BARS. F.Soška.
Czech. J. Phys., Vol. 6, No. 6, 558-73 (Dec., 1956).

The equations of motion for pure (mutually independent) longitudinal, torsional and flexural oscillations of very thin piezoelectric bars are derived systematically and in detail, first in integral and then in differential form. Attention is paid to the effect of external and internal damping, and the method of exciting the individual oscillations is considered.

534.133 : 537.228.1

4367. ELECTRICAL EQUIVALENT CIRCUIT OF DAMPED SHEAR VIBRATIONS OF PIEZOELECTRIC BARS. F.Soška.
Czech. J. Phys., Vol. 8, No. 1, 17-31 (1958). In Russian, with summary ($\frac{1}{2}$ p.) in English.

534.133

4368. EXPERIMENTAL DETERMINATION OF THE AMPLITUDE OF VERY HIGH FREQUENCY VIBRATIONS OF QUARTZ SUBMERGED IN A LIQUID.

S.Parthasarathy and H.Singh.

J. Phys. Radium, Vol. 19, No. 12, 920-2 (Dec., 1958). In French.

The thermosonic method was used. It is found that the amplitude varies inversely as the acoustic impedance of the liquid. Very good agreement is observed between the experimental and the theoretical values of the amplitude.

534.142

4369. ANALYSIS OF HEAT-DRIVEN OSCILLATIONS OF GAS FLOWS. I. GENERAL CONSIDERATIONS. H.J.Merk.

Appl. sci. Res. A, Vol. 6, No. 4, 317-36 (1957).

Acoustic oscillations coupled with periodic changes in output of a heat source are discussed with special reference to a one-dimensional model comprising a disk-shaped heat source placed across a stream of gas in a tube. A characteristic equation for the frequencies of heat-driven oscillations is derived from considerations of continuity, momentum and energy. In addition to an acoustic mode of oscillation, there is an "entropy mode" which is damped out at a very short distance (~ 0.01 cm) upstream of the heat source and also a few cm downstream. J.G.Oldroyd

534.152

4370. A THERMO-OPTICAL METHOD FOR DETECTING AND MEASURING MECHANICAL VIBRATIONS. L.Bergmann.

Z.Naturforsch., Vol. 13a, No. 8, 599-602 (Aug., 1958). In German.

A simple optical system capable of measuring amplitudes of the order of 10^{-6} in. is described. Light from a 30-watt lamp passes through a grating having 30 opaque and transparent elements each about 0.33mm wide, and falls on a tiny mirror attached to the vibrating body. The reflected light, after transmission through a second identical grating with its grid elements arranged parallel to those of the first grating, is focused on a photoelectric cell, the amplified output of which is indicated on a meter. To demonstrate the equipment, the mirror was attached to one prong of a tuning fork which was excited by thermal impulses produced by passing the light of a projection lamp through a slotted rotating disc on to the base of the other prong. Other applications of the method are the demonstration and measurement of the radiometer effect and of radiation pressure. H.J.H.Starks

534.2

4371. TRANSIENT-WAVE PROPAGATION AND DIFFRACTION IN A TWO-LAYER MEDIUM WITH CYLINDRICAL BOUNDARY OF SEPARATION. I.A.Molotkov.

Vestnik Leningrad. Univ., (1958), No. 16, Ser. Fiz. Khim., No. 3, 51-64. In Russian.

Essentially a follow-up of a paper by G.I.Petrashen' (Uchenyya Zapiski Leningrad State University No. 170, 96-220, 1953). It is concerned with a study of the rapidly changing part of a field in the case of two media separated by the surface of a circular cylinder. The rapidly varying part of the solution is extracted from the whole expression represented by a Fourier series with radial functions in the form of Mellin integrals whilst the radial functions are investigated by the method of steepest descent. The expressions derived give the wave field near the front and in the region of geometrical shadow. C.R.S.Manders

534.21 : 533.7

4372. PROPAGATION OF DISTURBANCES AT HIGH FREQUENCIES IN GASES, LIQUIDS, AND PLASMAS. H.S.Green.

Phys. of Fluids, Vol. 2, No. 1, 31-9 (Jan.-Feb., 1959).

A method is developed for investigating the propagation of disturbances at small amplitude in fluids from the molecular or ionic standpoint. Adopting as variables the displacements of the particles from a configuration of thermal equilibrium, the equations of motion are derived, in statistical form, for both classical and quantum mechanics. It is shown how to apply this theory in the high-frequency region by neglecting the correlation between the displacements of neighbouring particles. Relaxation frequencies are defined, and it is shown that anomalous absorption and dispersion will be found in their neighbourhood. Beyond the relaxation frequency, the medium will show elastic or dispersive properties, according to whether the thermal velocities are below or exceed the velocity of propagation. A completely ionized system will have no relaxation frequencies.

534.22

4373. VELOCITY OF ULTRASONICS IN HALOGEN VAPORS.

E.G.Richardson.

J. Acoust. Soc. Amer., Vol. 31, No. 2, 152-4 (Feb., 1959).

The limiting values of the velocity of sound for high and low frequencies in the halogens in the gaseous state were calculated. Measurements at ultrasonic frequencies in three gases have confirmed dispersion of the velocity with relaxation times in the vicinity of 10^{-6} sec.

534.22

4374. ROTATIONAL RELAXATION IN NITROGEN, OXYGEN, AND AIR. M.Greenspan.

J. Acoust. Soc. Amer., Vol. 31, No. 2, 155-60 (Feb., 1959).

The speed and attenuation of sound at 11 Mc/s were measured in N_2, O_2, and dry air at various pressures between atmospheric and a few mm Hg. The rotational collision numbers were found to be: for N_2, 5.26 ± 0.05; for O_2, 4.09 ± 0.08; for air, 4.82 ± 0.18.

534.22

4375. MODIFICATIONS TO STANDARD PULSE TECHNIQUES FOR ULTRASONIC VELOCITY MEASUREMENTS.

A.Myers, L.Mackinnon and F.E.Hoare.

J. Acoust. Soc. Amer., Vol. 31, No. 2, 161-2 (Feb., 1959).

A description is given of modifications to the "sing-around" and coincidence techniques for velocity measurement. In the case of the "sing-around" method a gate is incorporated which effectively lengthens the ultrasonic path by allowing retriggering on multiply reflected pulses. This allows the use of short solid specimens having low attenuation. The coincidence technique is modified by using an unrectified r.f. display and an electronic counter-timer to measure the pulse recurrence frequency. In both methods, an accuracy of 1 in 10^4 can be achieved in measuring the transit time for 10 Mc/s waves through a low-absorbing specimen before correction is made for the effect of transducer-specimen bonds, etc.

534.22 : 532.7

4376. EXPERIMENTAL STUDY OF THE VELOCITY OF ULTRASOUND IN THE CRITICAL REGION OF LIQUIDS.

J.Noury.

J. Rech. Cent. Nat. Rech. Sci., No. 36, 217-59 (Sept., 1956). In French.

Liquid CO_2, N_2O,C_2H_6 and C_3H_8 were studied by a technique involving the diffraction of light by ultrasound. The pressure range studied was up to 150 atm. and the temperatures employed ranged from ambient up to about 150°C. For all the liquids investigated, increase of pressure caused a diminution of velocity, giving a minimum at the critical point, after which the velocity increased again. In general, the results agreed with those of other workers in the region below the critical point, but differed at higher pressures. Tests were only possible within the range from 0.585 to 3.4 Mc/s and showed little evidence of dispersion of velocity with frequency. From the velocity of ultrasound and the experimental values of the equations of state of the liquids, it was possible to compute their ratios of specific heats. The velocity of ultrasound in the critical region was also computed from the available theoretical and semi-empirical equations; in general it was found to be higher than the measured values. A.C.Whiffin

534.22 : 541.135

4377. ULTRASONIC STUDIES IN ELECTROLYTES: NON-AQUEOUS SOLUTIONS. B.Krishnamurty.

J. sci. industr. Res., Vol. 17B, No. 12, 475-9 (Dec., 1958).

Ultrasonic velocities and adiabatic compressibilities of non-aqueous solutions of four inorganic salts (potassium chloride, potassium bromide, sodium chloride and ammonium chloride, in methyl, ethyl and n-butyl alcohols) were determined at 29°C, in the concentration range 0.0001-0.001 mole/litre. The departures exhibited by these solutions from the laws derived from the Debye–Hückel theory are explained as due to incomplete dissociation of the salts in these solvents of low dielectric constants. The same salts were also investigated in water, in the same concentration range, for a comparative study of the behaviour of the electrolytes in the alcohols and water. For those salts which exhibited a departure from theoretical relation, the concentration at which the departure occurs is shifted to lower values in solvents of lower dielectric constants. For those salts which show a linear variation of velocity or compressibility with concentration, the gradients of the curves are less in solvents of lower dielectric constant.

534.222.2

4378. A NOTE ON THE PROPAGATION OF A SOUND PULSE IN A TWO-LAYER LIQUID MEDIUM. J.H.Rosenbaum.

J. geophys. Res., Vol. 64, No. 1, 95-102 (Jan. 1959).

The contribution from the branch line integral in Pekeris' formulation (1948) of the propagation of explosive sound in a two-layer liquid medium is investigated. It is shown that there is no net contribution to the solution in terms of pressure amplitude measured in the upper layer, which decays less rapidly than r^{-2}. The horizontal range, designated by r, is large compared with the depth of the layer. This result is applicable to early arrival pressure signals and is in agreement with recently published model experiments.

534.222.2

4379. NEW SUPERSONIC PHENOMENA. W.Philippoff.

Nature (London), Vol. 182, 1011-12 (Oct. 11, 1958).

Evidence is presented for an unexpected pattern of standing waves in glass, Perspex, and CR39 resin blocks which were excited by detonating lead azide on their surfaces, and examined by polarized light. Time measurements suggest waves travelling at greater than 30 000 m/s and these may be propagated on the surface of the sample. H.D.Parbrook

534.222.2

4380. PRECISION FLASH X-RAY DETERMINATION OF DENSITY RATIO IN GASEOUS DETONATIONS.

R.E.Duff, H.T.Knight and J.P.Rink.

Phys. of Fluids, Vol. 1, No. 5, 393-8 (Sept.-Oct., 1958).

An X-ray densitometer was used to measure the density ratio across a detonation wave in a number of different gaseous mixtures involving C_2H_2, C_2N_2, or H_2 with O_2 and Kr. In a 3 in. i.d. tube at an initial pressure of 60 cm the density ratios observed were between 1.64 and 1.67. Investigations of the influence on density ratio of tube diameter at constant initial pressure and of initial pressure at constant tube diameter both indicate an extrapolated infinite diameter density ratio of 1.70 for a 0.3 C_2H_2 + 0.3 O_2 + 0.4 Kr mixture. This result is significantly lower than the ratio 1.79 which corresponds to the tangent point on the equilibrium Hugoniot from the initial state. At the present time these observations cannot adequately be explained by detonation theory.

534.222.2

4381. TRANSITION FROM SLOW BURNING TO DETONATION IN GASEOUS EXPLOSIVES. F.J.Martin.

Phys. of Fluids, Vol. 1, No. 5, 399-407 (Sept.-Oct., 1958).

High-speed photographic observations were made of flame structure, flame velocity, and shock velocity during the transition from slow burning to detonation in acetylene–oxygen mixtures contained in glass pipe at reduced pressures. During intermediate stages the dome-shaped flame travels down the tube at about 800 m/sec and is preceded by a shock wave travelling slightly faster. During the final stages of formation of the detonation wave, the flame changes shape, accelerates, and advances along the walls in an asymmetric manner. The final flame acceleration occurs when the Reynolds number of the mass flow between the flame and the preceding shock, based upon the distance travelled by a mass element in the time interval between passage of the shock and the flame through it, is about 10^7. Under these conditions the development of turbulent regions in the boundary-layer flow ahead of flame appears likely. Changes in flame configuration which result in the final acceleration and the formation of the detonation wave then arise from the faster flame propagation into these turbulent areas than into the free-stream region.

534.222.2

4382. ENERGY PARTITION IN THE EXPLODING WIRE PHENOMENA. F.D.Bennett.

Phys. of Fluids, Vol. 1, No. 6, 515-22 (Nov.-Dec., 1958).

Streak camera and oscillographic circuit-damping data are presented for exploded copper wires varying in diameter from 3 to 8 mils. A maximum of specific shock-wave energy in the induced flow is found at a wire diameter different from that of a minimum in the total damping time of the circuit. This displacement is shown to be caused by the presence of residual circuit resistance. The proof is placed on a critical analysis of optimum damping conditions in the exploding wire circuit. A maximum of apparent energy within the contact surface appears at about the same wire diameter as the minimum of total damping time. Discussion of the implications of the Taylor–Lin similarity theory indicates that lack of similarity of the flow is probably connected with the displacement of the maximum energies associated with shock-wave and contact surface.

534.222.2

4383. MEASUREMENT OF THE REFLECTED SHOCK HUGONIOT AND ISENTROPE FOR EXPLOSIVE REACTION PRODUCTS.

W.E.Deal.

Phys. of Fluids, Vol. 1, No. 6, 523-7 (Nov.-Dec., 1958).

Measurement of the hydrodynamic state in an inert material adjacent to an interface with a detonating explosive yields a data point on the reflected shock Hugoniot of the explosive reaction products centred at the Chapman–Jouguet state or on the isentrope below this state. Such measurements were made, using various in materials, for a range of shock impedances which yields pressures in the explosive reaction products from 515 000 bars down to 571 b The data fit a polytropic equation of state (P/ρ^{γ} = const. for the ise trope) with γ = 2.77.

534.222

4384. A DETONATION-PRODUCT EQUATION OF STATE OBTAINED FROM HYDRODYNAMIC DATA.

W.Fickett and W.W.Wood.

Phys. of Fluids, Vol. 1, No. 6, 528-34 (Nov.-Dec., 1958).

A recent experimental measurement of the Chapman–Jouguet isentrope of the solid explosive Composition B (see preceding abstract) together with the experimental detonation velocity versus initial density curve, give considerable information about the equat of state of the detonation products. With the aid of some thermodynamic assumptions, a simple explicit form is obtained for the energy as a function of pressure and volume.

534.222

4385. EXPLOSIVELY INDUCED NONUNIFORM OBLIQUE SHOC

J.O.Erkman.

Phys. of Fluids, Vol. 1, No. 6, 535-40 (Nov.-Dec., 1958).

At the high pressures induced by explosive attack, metals are assumed to behave like nonviscous, non-heat-conducting fluids. Within these assumptions, intensity and duration of explosively induced nonuniform oblique shocks are calculated by the method of characteristics for aluminum and copper in those cases involving supersonic flow both in the metal and in the explosive gas. Flow in both metal and explosive product gas is assumed to be isentropic even in the presence of shock waves. When a three-parameter equation of state is used for the gas, an arbitrary assumption must be made concerning the magnitude of one of these parameters, since pressure, density, and sound speed are known only for the Chapman–Jouguet point for the explosive gas. Reasonableness of this assumption is tested by comparing the results of the calculatio with experiment. Results for oblique shocks confirm the results obtained previously for plane shocks in regard to the equation of state of the gas.

534.222.2 : 533.6.011.

4386. ON CURVED SHOCK WAVES IN THREE-DIMENSIONAL GAS FLOWS. R.P.Kanwal.

Quart. appl. Math., Vol. 16, No. 4, 361-72 (Jan., 1959).

Theoretical. Relations are derived giving the gradients of pressure, velocity, etc., behind a curved shock surface in terms of the flow in front, for a gas of constant γ, neglecting dissipative processes. It is shown that the flow behind the shock can remain irrotational only for certain special surfaces (plane, cone, cylinder helicoid). J.Hawgoo

534.222.2 : 532.5 : 538.

MAGNETOHYDRODYNAMIC FLOW IN A SHOCK TUBE. See Abstr. 3656

534.222.2 : 541.12

LIMITATIONS OF THE REFLECTED SHOCK TECHNIQUE FOR STUDYING FAST CHEMICAL REACTIONS. See Abstr. 4087

534.222.2 : 531.5

GENERATION OF HIGH-VELOCITY PROJECTILES. See Abstr. 4326

534.222.2 : 778.37 : 535.3

HIGH-SPEED MULTIPLE-SPARK LIGHT SOURCE FOR SHOCK WAVE STUDIES. See Abstr. 4507

534.23 : 538.69

4387. MAGNETIC FIELD DEPENDENCE OF ULTRASONIC ATTENUATION IN METALS AT LOW TEMPERATURES.

S.Rodriguez.

Phys. Rev., Vol. 112, No. 1, 80-9 (Oct. 1, 1958).

A theory of the constant magnetic field on the behaviour of ultrasonic attenuation in normal metals at low temperatures of the order of liquid helium temperatures is given. The ideas are of the same kind as those suggested by Pippard to account for the attenuation in the absence of an external field. The different geometries are specified by the directions of three vectors, the wave vector q of the acoustic wave, the direction of polarization u_0, and the external magnetic field H_0. The analysis shows that, for a transverse wave polarized in the direction of H_0 (i.e., u_0 and H_0 are parallel and both are perpendicular to q) the attenuation decreases as $|H_0|^{-2}$ for large fields. When u_0 and H_0 are perpendicular and q is perpendicular to both, the attenuation increases as $|H_0|^2$ for large $|H_0|$. For a wave such that u_0 and q are parallel and H_0 is perpendicular to q, the attenuation increases asymptotically to a constant value as $|H_0|$ increases. The maxima and minima obtained experimentally by Morse and co-workers cannot be explained on this model. An absorption similar to that occurring in cyclotron resonance absorption is obtained in the attenuation of transverse waves (u_0 perpendicular to q) when H_0 is parallel to q.

534.23

4388. ON ABSORPTION OF FINITE-AMPLITUDE SOUND [WAVES] IN A RELAXING MEDIUM. A.L.Polyakova.
Dokl. Akad. Nauk SSSR, Vol. 122, No. 1, 51-3 (1958). In Russian.

An acoustic wave of finite amplitude, originally sinusoidal, becomes saw-tooth in form as it propagates through a real medium. Such a saw-tooth wave is absorbed more strongly than a wave of infinitely small amplitude. The present paper deals theoretically with absorption of acoustic waves of finite amplitude in a medium in which the energy of the progressive motion of molecules is transferred to their internal degrees of freedom. Such a process produces relaxation and consequently absorption of those acoustic frequencies which are close to the relaxation frequency.

A.Tybulewicz

534.23

4389. ABSORPTION OF LARGE-AMPLITUDE ULTRASONIC WAVES IN SOLUTIONS WITH A STRUCTURE.
I.G.Mikhaĭlov and N.M.Fedorova.
Akust. Zh., Vol. 3, No. 3, 239-42 (1957). In Russian.

Absorption of 5 Mc/s waves in solutions of polyisobutylene in benzene and of perbutane in toluene was found to destroy the solution structure above certain threshold intensities.

534.23 : 612.1

4390. ABSORPTION OF SOUND ARISING FROM THE PRESENCE OF INTACT CELLS IN BLOOD. E.L.Carstensen and H.P.Schwan.
J. Acoust. Soc. Amer., Vol. 31, No. 2, 185-9 (Feb., 1959).

The absorption of sound in blood occurs primarily on a molecular level and is related to the presence of protein in the cells and plasma. However, a small contribution to the total absorption arises simply from the presence of intact cells in the blood. Analysis based on Epstein's theory of scattering shows that the cellular absorption results from a viscous interaction between the fluid and cells when the latter, because of their greater density, fail to follow the oscillatory motion set up by the sound wave.

534.23

4391. ULTRASONIC ABSORPTION BY SOME KETONES.
S.Parthasarathy and V.Narasimhan.
J. Phys. Radium, Vol. 19, No. 12, 957-9 (Dec., 1958). In French.

The ultrasonic velocity and absorption coefficients of several ketones were measured at several temperatures and the results compared with those of earlier workers. For most of the liquids studied the temperature coefficient of absorption was positive in the range of temperature employed. Cyclohexanone was the one liquid which showed a positive temperature coefficient up to 30°C and a negative temperature coefficient above that.

534.23

4392. ULTRASONIC ABSORPTION AND DISPERSION IN MONOATOMIC GASES: THE THREE SOURCES OF CLASSICAL IRREVERSIBILITY. M.Huetz-Aubert and J.Huetz.
J. Phys. Radium, Vol. 20, No. 1, 7-15 (Jan., 1959). In French.

The study of dispersion and absorption effects, so called "classical effects" or effects of translation since they affect the molecular degrees of freedom, is most useful in order to separate the global effects which are the only ones accessible to experiment, from those which are due to intramolecular relaxation. As this latter cannot affect the behaviour of monoatomic gases, the experimental control is easier if it is confined to these gases. Viscosity and conduction are the most important classical effects, but radiation leads to dispersion and absorption equations identical to those which are found by relaxation. Thus irreversibility does not essentially differ according to its inter or intramolecular origin. It can thus be concluded that the theory of effects of translational absorption and dispersion is verified.

534.23 : 539.2

4393. THEORY OF ULTRASONIC ABSORPTION IN METALS. THE COLLISION-DRAG EFFECT. T.Holstein.
Phys. Rev., Vol. 113, No. 2, 479-96 (Jan. 15, 1959).

A basic assumption of the semiclassical treatment of ultrasonic absorption in metals is that of "collision drag". This assumption states that, in the presence of an impressed ultrasonic wave, the velocity distribution towards which the conduction electrons relax is a Fermi distribution centred, not at the origin of velocity space, but at a point, v_i, equal to the local, impressed lattice-displacement velocity. In the present paper, the explanation of this collision-drag effect in terms of basic electron-lattice theory is investigated for the case of collisions with thermal vibrations. The effect is found to originate from those higher-order terms in the electron-lattice interaction whose matrix elements are bilinear in the amplitudes of impressed and thermal lattice displacements. In the conventional perturbation-theory treatment, these matrix elements give rise to transitions in which both a thermal phonon and an impressed phonon are simultaneously either absorbed or emitted. However, in such a treatment, no collision-drag effects appear. In order to obtain them, it is necessary to alter the standard perturbation treatment so as to provide for space-time localization of collisions to within an interval small compared to the wavelength and period of the impressed sound wave. It is then found that the impressed ultrasonic wave produces a modification in the energy-conservation law of electron-lattice collisions, $\epsilon_{k'} = \epsilon_k \pm \hbar\omega_\lambda$, in which the effective electron energy, ϵ_k, is the Bloch energy, augmented by a term proportional to the impressed displacement velocity. When this modification is introduced into the collision term of the Boltzmann transport equation, equilibrium distribution (defined as that for which the collision term vanishes) is found to be a Fermi distribution centred about a point in k-space equal to $mv_i/\hbar$; for the free-electron model, this result is in accord with the collision-drag assumption as stated above. An additional result of the treatment is that the crystal-momentum conservation law of electron-lattice collisions is altered by the inclusion of terms linearly proportional to the impressed strain; this modification, however, turns out to have no effect in ultrasonic absorption. The final section of the paper is devoted to an investigation of the effects on energy transfer arising from the bilinear matrix elements; these effects are shown to be describable, also, in terms of the collision-drag picture.

534.23 : 538.69

4394. NEW OSCILLATORY ABSORPTION OF ULTRASONIC WAVES IN BISMUTH IN A MAGNETIC FIELD. D.H.Reneker.
Phys. Rev. Letters, Vol. 1, No. 12, 440-2 (Dec. 15, 1958).

Ultrasound [of undefined nature or direction of travel, though it may be inferred that megacycle frequencies were used], propagated in a $>99.999\%$ pure bismuth single crystal in the presence of a magnetic field which is normal to the trigonal axis, is reported to be absorbed with a wavelength-independent periodicity in reciprocal magnetic field, when the field is of the order of 10^3 oersteds. The periodicity is the same (to ±10%) as that of the de Haas—van Alphen effect. A progress report is also made on a study of the Fermi surface from oscillations of the known magnetoacoustic type; this absorption is stated to saturate at high fields. [The temperature of the experiments is undisclosed throughout].

L.Mackinnon

534.231

4395. ACOUSTIC FIELD OF A CIRCULAR PISTON IN THE NEAR ZONE. R.H.Quint.
J. Acoust. Soc. Amer., Vol. 31, No. 2, 190-1 (Feb., 1959).

By a power series expansion method an expression for the radiation potential of a circular piston mounted in an infinite baffle is derived. All points of the piston vibrate in phase and with equal amplitude in an infinite medium characterized by wavelength λ. The series expression is shown to be convergent at the surface of the piston ($Z = 0$) when $ka \geq 20$, and $r < a/2$. Expressions useful for the paraxial region are obtained when $0 \leq Z \leq a/2$, where a is the piston radius and $ka > 100$. For $Z \gg a$, the Schoch expression is obtained.

534.232

4396. DESCRIPTION OF THE RESONANCES OF SHORT SOLID BARIUM TITANATE CYLINDERS. J.S. Arnold and J.G.Martner.
J. Acoust. Soc. Amer., Vol. 31, No. 2, 217-26 (Feb., 1959).

The distributions of axial and radial vibration on the plane surfaces of short solid cylinders (disks) of barium titanate were experimentally determined for a number of modes. A vibration mode chart was prepared, to relate the types and frequencies of the prominent modes to the cylinder size and geometry. The electrical and mechanical aspects of the disk vibration indicate that there is no simple relationship between the electrical and mechanical measurements that are indicative of vibration amplitudes in different modes. A tentative explanation of this phenomenon is suggested by the experimentally disclosed existence of circulating currents in the disk electrodes.

534.24 : 538.566

REFLECTION AND DIFFRACTION OF ACOUSTIC WAVES AND PULSES BY WEDGES AND CORNERS. See Abstr. 3669

534.26

4397. CORRECTION FOR DIFFRACTION LOSSES IN THE ULTRASONIC FIELD OF A PISTON SOURCE. E.P.Papadakis.

J. Acoust. Soc. Amer., Vol. 31, No. 2, 150-2 (Feb., 1959).

In ultrasonic attenuation experiments carried on by the pulse method, it is important to know the part of the measured attenuation contributed by diffraction in the ultrasonic field. In certain cases, particularly at the lower megacycle frequencies, the diffraction loss can be much greater than the attenuation intrinsic to the specimen. The diffraction loss in decibels has been computed elsewhere as a function of the distance the ultrasonic pulse travels back and forth in the sample. Here an expression for the increment to the attenuation is derived taking into consideration at which echoes the decibel drop is measured. It is shown that the first echo has suffered a considerable loss at the lower frequencies and that one must consider that loss in computing the increment to the attenuation caused by diffraction if that echo was used as one at which the decibel loss is measured. If that loss is not considered, the incremental attenuation will be excessive.

534.321.9 : 532.62

ULTRASONIC ATOMIZATION OF LIQUIDS. See Abstr. 4342

534.372

4398. THIRD "RESONANT" FREQUENCY FOR A TWO DEGREE OF FREEDOM SYSTEM WITH COULOMB DAMPING. W.J.Worley.

J. Acoust. Soc. Amer., Vol. 30, No. 10, 989 (Oct., 1958).

This note considers a system of mass m_2 mounted on a spring k_2 which is in turn attached to a sinusoidally vibrating platform; another mass m_3 is attached to m_2 by a spring k_3 and a damper c_3. The resonant frequencies of the system are derived when $c_3 = 0$ (ω_1 and ω_2) and when c_3 is very large (ω_3). If c_3 is replaced by a Coulomb damping force and ω_3 approaches ω_1 or ω_2, the calculations suggest there is a resonant peak at a third frequency which the author says has been observed in tests of apparatus using Coulomb damping. H.J.H.Starks

534.39 : 537.36

4399. ACOUSTOELECTRIC EFFECT. R.H.Parmenter.

Phys. Rev., Vol. 113, No. 1, 102-9 (Jan. 1, 1959).

Discusses three general approaches to the theory of the acoustoelectric effect (see Abstr. 3066/1953) — the equilibrium, the transport, and the phenomenological approaches. The fact that these three approaches have led to mutually conflicting conclusions is attributed to three causes. (1) The last approach is applicable only when the mean free path of the charge carriers is much smaller than the acoustic wavelength; the first two approaches, only when the mean free path is much greater than the wavelength. (2) The transport approach of necessity ignores the contribution of charge carriers "trapped" by the acoustic wave. (3) The phenomenological approach, as previously developed, ignores the contribution to the space-charge density coming from the ion-cores of a metal or the ionized impurity atoms of a semiconductor. In this paper a development of the phenomenological approach is given in detail for metals and for semiconductors. This is the approach appropriate under most experimental conditions, but at sufficiently low temperatures and high acoustic frequencies the equilibrium approach is appropriate in metals and semimetals. It is pointed out that the acoustoelectric effect may be considerably enhanced by the application of a magnetic field.

534.39 : 535.371

ACTION OF ULTRA-SOUND ON THE LUMINESCENCE OF ZINC SULPHIDE SCREENS UNDER CONTINUOUS EXCITATION BY LIGHT. See Abstr. 3312

534.422

4400. SIREN DESIGN FOR PRODUCING CONTROLLED WAVE FORMS AT HIGH INTENSITIES. C.H.Allen and B.G.Watters.

J. Acoust. Soc. Amer., Vol. 31, No. 2, 177-85 (Feb., 1959).

On the assumption of the additivity of steady and acoustic flow characteristics, an equation was developed for the time variation of a siren port area required to produce a sinusoidal wave. If low efficiencies can be tolerated the port opening may be kept small and the operating pressure made large compared with the acoustic pressure; then the equation reveals the well-known fact that the proper port area variation is nearly sinusoidal. For high efficiencies the operating pressure must be made to approach the peak acoustic pressure and the port area variation must depart widely from a sinusoid if a sinusoidal pressure wave is to be generated. A siren was designed and built to verify the assumptions. The output signal was found to be sinusoidal at the design operating pressure and to depart from sinusoidal as expected at operating pressures either higher or lower. Efficiency at the design pressure was between 35 and 45% which is between 70 and 90% of the theoretical maximum efficiency for a sinusoidal sound generator of the siren type using a dissipative valving mechanism. The derived equation might be use to determine the port area variation of a siren for generating a chosen nonsinusoidal wave-form by substituting, within limits, the expression for the desired wave in place of the sine function.

534.4

4401. SPACE REQUIREMENTS FOR EQUIPMENT ITEMS SUBJECTED TO RANDOM EXCITATION. J.A.Skoog and G.G.Setterlun

J. Acoust. Soc. Amer., Vol. 31, No. 2, 227-32 (Feb., 1959).

If an equipment item is supported on a low-frequency mounting there must be sufficient space allowance around the item to permit unrestricted vibratory motion. Also, the motion of the equipment item must be within the allocated travel of the mount. If the system is linear, the required space can be computed for random motion b the application of Fourier series. The solution includes motion of the adjacent structure and phase angles. After a review of basic random theory showing the application of random theory to design, an expression is developed for calculating the space required for a equipment item to vibrate. A numerical example is included to illustrate a method for estimating structural response and structur phase.

534.61

4402. ON THE MEASUREMENT OF PRESSURE CORRELATIONS FOR RANDOM VIBRATION STUDIES. A.Powell.

J. Acoust. Soc. Amer., Vol. 30, No. 9, 878 (Sept., 1958).

Theoretical note suggesting the use of an electrical filter as a analogue of the mechanical motion of each normal mode of a structure subjected to a random pressure field. H.D.Parbroo

534.612

4403. DETECTING SOUND FIELDS. C.B.Sacerdote.

J. Acoust. Soc. Amer., Vol. 31, No. 2, 133-6 (Feb., 1959).

A feedback method is described, permitting a loudspeaker to be driven automatically so that the sound pressure generated at any one point is constant with frequency, independent of the loudspeaker characteristics. Several applications illustrate the success of the method in the calibration of microphones and in the study of diffraction and reflection effects.

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also the Section entitled "BIOPHYSICS. PHYSIOLOGICAL PHYSICS".

534.771

4404. EFFECT OF BACKGROUND NOISE ON THE AUDITORY INTENSIVE DIFFERENCE LIMEN. C.E.Sherrick, Jr.

J. Acoust. Soc. Amer., Vol. 31, No. 2, 239-42 (Feb., 1959).

A study of the effect of random background noise on the intensiv difference limen (DL) for pure tones was made by a method similar to that developed by Riesz. Three frequencies (250, 1000, and 4000 c/s) at three sensation levels (20, 40, and 60 dB) were studied, with signal-to-noise ratios of −15, −10, 0, and 10 dB present for each condition. Analysis of the data revealed only signal-to-noise ratio as a significant factor affecting the DL. Repetition of the experiment with the psychophysical method of average error, for a 1000 c/s signal at levels of 10, 30, 50, and 70 dB, and signal-to-noise ratios of −10, 0, 10 and 20 dB resulted in a lack of systematic shift of the difference limen. The curve relating the difference limen obtained by modulation to signal-to-noise ratio appears to parallel that found in quiet when the difference limen is plotted against sensation level. Some hypotheses relating to the differences of psychophysical procedure are stated.

534.781 : 612.85

INTELLIGIBILITY OF PEAK-CLIPPED SPEECH AT HIGH NOISE LEVELS. See Abstr. 4190

534.79

4405. THE LOUDNESS SENSATION OF RHYTHMIC NOISES OF VERY LOW FREQUENCY. H.Niese.

Hochfrequenztech. u. ElektAkust., Vol. 67, No. 1, 26-34 (July, 1958). In German.

Experiments have been made on matching the loudness of a thousand cycle tone with short bursts of the same tone at frequencies of 1-100 c/s and the apparent loudness is of the order of 10 dB less. J.M.Hough

534.79 : 612.85

DISCRIMINABILITY CRITERION FOR A LOUDNESS SCALE. See Abstr. 4182

534.81

4406. ON WOODWIND INSTRUMENT BORES. A.H.Benade.

J. Acoust. Soc. Amer., Vol. 31, No. 2, 137-46 (Feb., 1959).

The properties of horns that are suitable for use in woodwinds are deduced from first principles. The cylindrical pipe and complete cone are shown to be the only shapes which satisfy these requirements exactly. The behaviour of nearly perfect cylinders and almost complete cones is described, the influence of closed finger holes on the effective bore of an instrument is discussed, and the effect of the mouthpiece cavity is analysed. Damping of the normal modes by the walls of the bore is shown to play a dominant role in the playing behaviour and tone colour of woodwinds, and various consequences are deduced.

534.83

4407. FLUCTUATIONS OF SCATTERED NOISE. L.Mittenthal.
J. Acoust. Soc. Amer., Vol. 30, No. 9, 876-7 (Sept., 1958).

The coefficient of variation of scattered sound is shown to be a decreasing function of the number of frequency components. The limit is found and the distribution of the r.m.s. value of scattered narrow band random noise is shown to be a Dirac delta function.

H.D.Parbrook

534.83

4408. STRENGTH DISTRIBUTION OF NOISE SOURCES ALONG A JET. H.S.Ribner.
J. Acoust. Soc. Amer., Vol. 30, No. 9, 876 (Sept., 1958).

Brief report of a theoretical extension of Lighthill's theory (Abstr. 3372/1952) predicting that the majority of jet noise power is emitted from the mixing region. H.D.Parbrook

534.83 : 533.6.011.5

4409. EFFECT OF JET STRUCTURE ON NOISE GENERATION BY SUPERSONIC NOZZLES. H.R.Mull.
J. Acoust. Soc. Amer., Vol. 31, No. 2, 147-9 (Feb., 1959).

In this study the near noise field of a supersonic jet (Mach 2.87), exhausting into quiescent air, is analysed with respect to the aerodynamic structure of the jet. The noise field is shown to be shifted away from the jet exit with the most intense sound near the end of the supersonic portion of the exhaust structure. Downstream of this point, the jet radiates noise in the same manner as a subsonic jet.

OPTICS . SPECTRA . LUMINESCENCE

535.218 : 538.24

INFLUENCE OF LIGHT UPON THE MAGNETIZATION OF MASSIVE IRON. See Abstr. 3644

535.222

4410. A PROPOSED METHOD FOR THE MEASUREMENT OF THE VELOCITY OF LIGHT. J.H.Sanders.
Nature (London), Vol. 183, 312 (Jan. 31, 1959).

Methods for measuring the velocity of light have been limited by the upper frequency limit of amplitude modulation of a light source. Since the correlation of photons in coherent light is now established (Abstr. 9588/1957) direct modulation is no longer necessary. A method is proposed that is conditional on the development of an optical maser. This should emit lines considerably narrower in frequency spread than the proposed level splitting of 1-10 kMc/s. The two frequencies would be mixed in a suitable photosensitive device, and an arrangement is outlined in which the difference frequency signal would have an amplitude dependent on the path difference, the frequency difference and the light velocity.

D.Walsh

535.222

4411. SIMPLE ELECTRICAL METHOD FOR THE DIRECT MEASUREMENT OF THE VELOCITY OF LIGHT FOR USE IN LECTURES AND LABORATORY DEMONSTRATIONS. W.Kroebel.
Optik, Vol. 14, No. 7-8, 353-60 (July-Aug., 1957). In German.

Permits measurement over short distances of 5-10 m to within less than 1%. The method is simple, reducing the measurement to a determination of a time interval on a c.r.o. and a measurement of distance.

535.23.08 : 536.33.08

THE NATURAL LIMITS OF SENSITIVITY OF METAL BOLOMETERS. See Abstr. 3384

535.237

4412. THE REPRESENTATION OF THE SPECTRAL ENERGY DISTRIBUTION OF SOURCES OF RADIATION. L.Foitzik.
Exper. Tech. der Phys., Vol. 1, No. 4-5, 209-13 (Nov.-Dec., 1953). In German.

A theoretical paper, expressing the radiation energy in different units, and showing that the correct unit for the energy is Watts.cm^{-2}.

C.Turner

535.242.2 : 771.376

A PHOTOMETRIC-WEDGE EXPOSURE METER. See Abstr. 4193

535.245

4413. MEASUREMENTS ON RETRO-REFLECTING MATERIALS. J.Krochmann.
Lichttechnik, Vol. 10, No. 10, 515-18 (Oct., 1958). In German.

Discusses the errors made in the measurement of the luminance factor of a retro-reflecting material due to (a) the sizes of the specimen and of the source and receptor (usually a photocell) relative to the distance at which the measurements are made, and (b) the angle between the directions of incidence and reflection at the material. Materials are classified according to the angle at which the luminance factor falls to half its value at normal incidence.

J.W.T.Walsh

535.247

4414. INEXPENSIVE RECORDING MICRODENSITOMETER. R.L.Purbrick.
Amer. J. Phys., Vol. 27, No. 4, 264-5 (April, 1959).

A simple recording microdensitometer constructed largely from government surplus property is described.

535.247

4415. TWO NEW DENSITOMETERS. H.Mütze.
Exper. Tech. der Phys., Vol. 1, No. 4-5, 206-8 (Nov.-Dec., 1953). In German.

The two densitometers are, a projection apparatus, reproducible to 0.1% density and linear over a density range 0-2.5, and a high-speed recording apparatus for densities 0-2.5, with an accuracy of 1%.

C.Turner

535.317.25

4416. IMPROVED SINUSOIDAL TEST CHARTS. D.H.Kelly, M.E.Lynch and D.S.Ross.
J. Opt. Soc. Amer., Vol. 48, No. 11, 858-9 (Nov., 1958).

A master chart was made as described in Abstr. 4258 (1957) and irregularities in this were smoothed by re-photographing it moving parallel to the ruled direction. This was then recopied at different magnifications.

W.T.Welford

535.317.6 : 522.24

4417. TELESCOPE DOUBLETS. R.E.Hopkins.
J.Opt. Soc. Amer., Vol. 49, No. 2, 200-1 (Feb., 1959).

The automatic design of a telescope doublet has been undertaken to show the influence of choice of glass upon the correction of zonal spherical aberration. Three choices of glass pairs were made and in each case parameters such as lens thickness, and spacing etc. kept at fixed values, while the machine determined optimum radii to give achromatism, zero third-order coma and marginal spherical aberration. The residual spherical aberration is determined for each case.

R.W.Fish

535.317.7

4418. A REVIEW OF THE APPLICATION OF GRATINGS TO THE STUDY OF OPTICAL ABERRATIONS. C.Morais.
Atti Fond. Ronchi, Vol. 13, No. 6, 546-602 (Nov.-Dec., 1958). In Italian.

A review of the theory of the Ronchi fringes and their use in measuring aberrations. The work of previous authors is unified into a complete account of the effects of the Seidel aberrations. The evaluation of the Seidel sums from the fringe patterns is demonstrated and sample photographs illustrate the principal results.

R.W.Fish

535.322.4 : 551.508.99

A NEW TYPE REFRACTIVE INDEX VARIOMETER. See Abstr. 4125

535.323

4419. ON THE THEORY OF THE TEMPERATURE DEPENDENCE OF THE REFRACTIVE INDEX OF INSULATORS AND SEMICONDUCTORS. F.Lukeš.
Czech. J. Phys., Vol. 8, No. 4, 423-34 (1958).

The theory is developed on the basis of the Lorentz theory of absorption and dispersion, which holds over a wide region of the spectrum, including the region of intrinsic absorption. For Ge, ZnS and SiO$_2$, it is shown that the theoretical results agree with the experimental results qualitatively, and for Ge quantitatively, to a satisfactory degree.

535.325

4420. REFRACTIVE INDEX OF AIR IN THE VISIBLE REGION OF THE SPECTRUM. T.Masui.
Rev. Opt., Vol. 36, No. 6, 281-4 (June, 1957). In French.

A general formula for the refractive index of air is derived as a function of wavelength, temperature, atmospheric pressure and of concentration of water vapour and carbon dioxide.

535.33.03

4421. HIGH INTENSITY LOW PRESSURE MERCURY VAPOUR LAMPS FOR RAMAN SPECTROSCOPY. G.Schreiber.
Exper. Tech. der Phys., Vol. 6, No. 2, 85-9 (1958). In German.

The design of various lamps is discussed and the performance considered in terms of line width and relative intensities of 4358 A compared with neighbouring lines and background. G.F.Lothian

535.33.07

4422. INTENSITIES IN THE INFRARED. A NOTE ON THE THEORY OF THE EXPERIMENTAL METHOD OF MEASUREMENT. J.Morcillo, J.Fernández Biarge and J.Herranz.
An. Real Soc. Espan. Fis. Quim., Vol. 52(A), No. 9-10, 193-206 (Sept.-Oct., 1956). In Spanish.

The correction due to the finite resolving power of the spectrograph is usually obtained by the approximate method of Wilson and Wells (Abstr. 592/1947). The problem is examined here in a more general way, and more rigorous methods are suggested.
L.Pincherle

535.33.07

4423. ROTATING MIRROR FOR PRESENTING SPECTRA WITH THE AID OF A CATHODE RAY TUBE. E.Palm.
Exper. Tech. der Phys., Vol. 4, No. 3, 136-8 (1956). In German.

A rotating mirror is used in front of the exit slit with which a range of 0.4-1.1 μ can be scanned in less than one millisecond. The plane mirror is situated between two 30° prisms, rotating around an axis so that the parallel beam penetrates the prisms in a plane parallel to their base for all angles of rotation. The mirror vibrates in its resonance frequency maintained by means of a small coil. The excitation current of the mirror frequency is used to control the X-deflection of the cathode rays to obtain synchronization.
C.Turner

535.33.07

4424. CURVES OF EQUAL DENSITY AS USED IN SPECTROPHOTOMETRY. E.Lau.
Exper. Tech. der Phys., Vol. 1, No. 4-5, 199-201 (Nov.-Dec., 1953). In German.

A photographic system is described, using the Sabatier effect, by forming two images of a line system at right angles to each other on the same plate. This can be applied to spectroscopy by first changing the intensities of a line to a two-dimensional image, by means of a cylindrical lens and a neutral wedge. C.Turner

535.33.07

4425. SEYA'S THEORY OF THE CONCAVE GRATING SPECTROMETER. H.Greiner and E.Schäffer.
Optik, Vol. 14, No. 6, 263-76 (June, 1957). In German.

A survey is made of spectrometers that use a concave grating employing a single reflection, i.e. those which are suitable for wavelengths below 1000 A. A brief resumé of Seya's theory is given. This theory provides the basis for the design of a spectrometer with fixed slits and rotatable grating for varying the wave length. Seya's calculations are modified and extended in several respects. An explicit expression is derived for the optimal angle between the incident and reflected rays at small angles of rotation of the grating. Graphs of the focal curves for different angles of rotation of the grating show the defocusing for angles deviating from the optimal value. It is seen that the positive orders of the spectrum involve less defocusing than the negative orders. The best grating width is estimated.

535.33.07

4426. GRATING MOUNTING FOR VACUUM ULTRAVIOLET MONOCHROMATOR. R.Onaka.
Sci. of Light (Tokyo), Vol. 7, No. 2, 23-7 (Aug., 1958).

A theory is developed which shows that a concave grating may be rotated about a suitable point outside the grating, to maintain the spectrum in focus for a range of wavelengths ($\Delta\lambda$) with fixed slits and a fixed direction of emergence through the exit slit. In a given case near 1800 A, $\Delta\lambda$ may be 600 A for Rayleigh resolution and much greater for wider slits. G.F.Lothian

535.33.0

4427. CONTRIBUTION TO THE PRACTICAL ATTAINMENT OF A SPECTROMETER WITH ROTATABLE CONCAVE GRATING. H.Greiner and E.Schäffer.
Z. InstrumKde, Vol. 66, No. 9, 188-91 (Sept., 1958). In German.

From the theory given earlier (Abstr. 181/1959), data on the optimum angles and distances for the slits are calculated and shown in curves and tables. G.F.Lothia

535.331/33

4428. RADIO-FREQUENCY SPECTROSCOPY OF EXCITED ATOMS. G.W.Series.
Rep. Progr. Phys., Vol. 22, 280-328 (1959).

Radiofrequency and optical spectroscopy are compared. Standard results in the theory of hyperfine structure are quoted. The excitation of atoms and the detection of radiofrequency resonances are discussed quantitatively. Experiments are described in which the techniques of "double resonance", electron impact, and atomic beams are used. A table of measurements is given.

535.33

4429. FINE AND HYPERFINE STRUCTURE OF SOME Mn I TERMS. G.Nöldeke.
Z. Phys., Vol. 153, No. 2, 164-73 (1958). In German.

Presents the calculation of the fine-structure and hyperfine-structure term energies of the terms belonging to the $3d^5 4s4p$ configuration of Mn I; the Mn III parent term of these terms in $3d^5\ {}^6S$. Various conclusions are drawn from the comparison of the calculated and measured energies. F.Lachma

535.331

4430. ON THE ISOTOPE SHIFT IN THE SPECTRUM OF GADOLINIUM. H.Kopfermann, L.Krüger and A.Steudel.
Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 258-64 (1957). In German.

Previous workers have shown that there is an abnormally large isotope shift for Nd$^{1-3}$ and Sm^4 between isotopes of neutron numbers 88—90. The isotope shift in the case of the gadolinium isotopes was therefore examined by means of a Fabry—Perot interferometer using gadolinium samples enriched in Gd 152 and Gd 154. Nineteen lines were examined and a large shift was observed between Gd 152 and Gd 154 (neutron no. 88 and 90 respectively). An estimate of the change in nuclear deformation is made. H.C.Cole

535.331

4431. ON THE HYPERFINE STRUCTURE IN THE SPECTRUM OF LUTETIUM AND THE NUCLEAR MOMENTS OF Lu^{175} AND Lu^{17} A.Steudel.
Z. Phys., Vol. 152, No. 5, 599-623 (1958). In German.

The Fabry—Perot spectra of five lines in the visible assigned to Lu I and Lu II are recorded photoelectrically. From the measurements the nuclear spin I(176) = 6 $\mp$ 1. The ratios for the two isotopes of the nuclear magnetic moments and the electric quadrupole moments are calculated from the measurements. Approximate absolute values of these quantities are also given. The structure of some Lu III lines measured by Meggers and Scribner (see Abstr. 3578/1937) is briefly discussed.
G.F.Lothian

535.332 : 535.337

4432. THE ELECTRICAL AND MAGNETIC EFFECT ON THE HYDROGEN LINE H$_\beta$ FOR FIELDS WHICH ARE CROSSED AT 90 DEGREES. W.Steubing and F.Lebowsky.
Z. Phys., Vol. 153, No. 1, 64-95 (1958). In German.

The splitting pattern of the H$_\beta$ line undergoes a continuous transition from the Zeeman effect through a region where both the magnetic and the electric field affect it to the Stark effect. The Zeeman effect predominates as long as $E/H < 1/25$. There is a superimposition of the action of both fields for $1/25 < E/H < \frac{1}{2}$, and a preponderance of the Stark effect for $E/H > \frac{1}{2}$. The ratios of the intensities of the blue and red components have been found to depend on the direction of the positive ray with regard to the electric field and also to the direction of the magnetic field.
R.Schnurmann

535.332 : 539.18

LIGHT EXCITATION IN THE BOMBARDMENT OF HELIUM WITH LIGHT AND HEAVY HYDROGEN. See Abstr. 3969

535.338.334

4433. LINE BROADENING IN PLASMAS OF HIGH DENSITY. G.Ecker.
Z. Naturforsch., Vol. 12a, No. 4, 346-7 (1957). In German.

A brief note on a correction to be made to the Holtsmark statistical theory of inhomogeneous field Stark broadening of spectral lines by positive ions. The effect of temperature (perturber velocity) must be taken into account. J.D.Craggs

535.34.07

4434. HIGH RESOLUTION INFRARED GRATING SPECTROMETER.
Appl. Spectrosc., Vol. 12, No. 6, 175-6 (1958).

A brief description of a single- or double-pass instrument with typical records showing a resolution of 0.025 cm^{-1} in the range 3-6 μ. G.F.Lothian

535.34.07

4435. INFRARED HIGH-RESOLUTION GRATING SPECTROMETER. E.K.Plyler and L.R.Blaine.
J. Res. Nat. Bur. Stand., Vol. 62, No. 1, 7-9 (Jan., 1959).

An infrared grating spectrometer which can be used as a single- or double-pass instrument has been built and set in operation. The collimating mirror has a focal length of 235 cm and the instrument has the highest resolution from 1600 to 3500 cm^{-1}. In order to have flexibility in scanning the spectra at different speeds, a special drive mechanism has been built which is made of spur gears and worm gears. The speeds range from 2.5 to 200 minutes of time per degree of rotation. Examples of the spectra resolved by the instrument are given. Lines separated by 0.05 cm^{-1} are completely resolved and two lines separated by 0.025 cm^{-1} are partially resolved.

535.34.07 : 621.373.421.14

4436. HIGH-Q STARK CAVITY ABSORPTION CELL FOR MICROWAVE SPECTROMETERS. A.Dymanus.
Rev. sci. Instrum., Vol. 30, No. 3, 191-5 (March, 1959).

Design considerations, description, and some data on the performance are given of a large pillbox-shaped Stark cavity absorption cell for the 1.25 cm wavelength region. The cavity can be used in any TE_{0m1} mode with m ranging from about 5 to about 12 and its most prominent features are: high loaded Q factor ($\sim 5 \times 10^3 - 10^4$), good electric insulation (at pressures below 4×10^{-2} mm Hg Stark voltages up to 3000 V can be applied), low Stark field inhomogeneity (diameter to length ratio 15-20), large band width (from about 18 to about 28 kMc), and low mode density. No cross-mode resonances occur and the only undesired modes excited appreciably are the TE_{2m1} ones. When used in transmission only the TE_{0m1} modes couple to the output. The cavity can be used at the same time as a reference cavity of a Pound-type klystron frequency stabilizer. The klystron frequency will then automatically follow the resonance frequency of the cavity over a frequency interval up to 400 Mc.

535.34.07

4437. ABSORPTION MEASUREMENTS AND IRRADIATIONS IN THE CARY AND BECKMAN SPECTROPHOTOMETERS, AT LOW AND HIGH TEMPERATURES. Y.Hirshberg and E.Fischer.
Rev. sci. Instrum., Vol. 30, No. 3, 197-9 (March, 1959).

Attachments to the Cary recording spectrophotometer and the Beckman D.U. spectrophotometer are described, which make it possible to use all-quartz optical cells for both for measurement of absorption spectra and for irradiations of liquid or solid samples, in the temperature range between -170° and $+200^\circ$. Gaseous heating and cooling agents are used throughout.

535.34.07

4438. A DOUBLE BEAM, DOUBLE AND MULTIPLE PASS INFRARED SPECTROPHOTOMETER. K.Kudo.
Sci. of Light (Tokyo), Vol. 5, No. 1, 1-3 (March, 1956).

The author describes a simple modification of a Walsh multiple monochromator. The addition of two small mirrors set at right-angles between the Walsh mirrors turns the system into a double beam arrangement. This eliminates errors due to atmospheric absorption. A sample recording is shown to illustrate the resolution obtainable. R.W.Fish

535.34.07

4439. A GRATING SPECTROMETER FOR THE REGION OF THE FAR INFRARED AND SHORT MICROWAVES.
L.Genzel, H.Happ and R.Weber.
Z. Phys., Vol. 154, No. 1, 1-12 (1959). In German.

An echelette grating about 50 cm wide consists of 128 Al plates mounted so that the depth of step is adjustable; the blaze can thus cover any wavelength in the region $\lambda = 0.2$ - 4.5 mm. Sources used are a Hg lamp ($\lambda < 1.2$ mm) and a klystron generator ($\lambda > 1.0$ mm). Filters used to remove unwanted radiation in various regions are tabulated. G.F.Lothian

535.34.07

4440. SPECTROSCOPY IN THE FAR INFRARED BY INTERFERENCE MODULATION. L.Genzel and R.Weber.
Z. angew. Phys., Vol. 10, No. 4, 195-99 (April, 1958). In German.

The theory of a previous paper (Abstr. 8711/1958) is summarized and elaborated. The method described is tried out with radiation from a Hg lamp passed through a slit to a laminar grating of step width 5 cm, and whose step depth oscillates periodically at $\frac{1}{2}$ c/s and at the same time is slowly increased. The reflected radiation passes through a slit to a Golay detector whose output goes to an amplifier tuned to the 25th harmonic. The absorption of water vapour in the range 200-1100 μ is so recorded in 30 min. G.F.Lothian

535.343 : 538.615

4441. ANOMALOUS g-SHIFTS OF EXCITED STATES OF Cr^{3+} IN RUBY. I.Tsujikawa and S.Sugano.
J. Phys. Soc. Japan, Vol. 13, No. 2, 220 (Feb., 1958).

The Zeeman effect of the doublets R_1 and R_2 of ruby, discussed by Tanabe and Sugano (Abstr. 9610/1957) were investigated at 20 and 4.2°K. The Zeeman levels of the ground state agree with those observed by magnetic resonance, but the $g_{e||}$-shifts of the excited states of R_1 and R_2 are anomalous. This anomaly is due to the effect of the third order perturbation $L_Z.V.V.\beta H_0$ (in which V is the trigonal field). C.Turner

535.343

4442. EFFECT OF PRESSURE ON THE SPECTRA OF CERTAIN TRANSITION METAL COMPLEXES.
R.W.Parsons and H.G.Drickamer.
J. chem. Phys., Vol. 29, No. 4, 930-7 (Oct., 1958).

The effect of pressure (to 130 000 atm.) was measured on the splitting of the 3d levels of the nickel and chromium ions complexed with water and ammonia. Data were also obtained on $CoSO_4.7H_2O$ and $K_3Fe(CN)_6$. In general, the effect of pressure is to increase the effect of the ligand field and to increase the splitting of the levels. This is interpreted in terms of the change in ligand—metal distance. A phase transition was noted in $[Ni(H_2O)_6]SO_4$ at 65 000 atm. A charge transfer band was also observed in $[NiNH_3)_6]Cl_2$. The effect of pressure is to increase the intensity with no apparent change in the location of the maximum.

535.343

4443. EXPERIMENTAL STUDY AND ATTEMPT TO INTERPRET FUNDAMENTAL ABSORPTION SPECTRA OF PURE CRYSTALS.
S.Nikitine.
J. Chim. phys., Vol. 55, No. 9, 621-41 (Sept., 1958). In French.

Absorption spectra were obtained for thin layers of Cu_2O, HgI_2, PbI_2, CuI, CuCl, CuBr, TlI, TlCl, TlBr, CdS and CdI_2. In all cases line structures occurred before the continuous spectrum. The line structures are divided into three classes, two of which correspond to the spectra predicted by exciton theory. The third class is dependent on the quality of the crystal. Emission and reflection spectra were also obtained. J.Franks

535.343

4444. SPECTROGRAPHY IN THE EXTREME ULTRAVIOLET. ABSORPTION OF NO, N_2O, H_2O, AND D_2O (GASEOUS). N.Astoin.
J. Rech. Cent. Nat. Rech. Sci., No. 38, 1-22 (March, 1957).
In French.

The range 100-1000 A was covered with a concave grating at grazing incidence in vacuo. The source was either a spark (sliding) or gas discharge, and the spectra were photographed. Short-wave overlapping orders may be removed by selective reflection. Absorption curves are reproduced and discussed in terms of excitation and ionization potentials. There are 122 references, about half concerned with instrument design. G.F.Lothian

535.343 : 538.222

4445. ABSORPTION LINES IN THE ANTIFERROMAGNETIC STATES OF $MnCl_2.4H_2O$ AND $MnBr_2.4H_2O$. I.Tsujikawa.
J. Phys. Soc. Japan, Vol. 13, No. 3, 315-16 (March, 1958).

Measurements have been made of the wavelengths and intensities of the violet doublet in the two materials between 20°K and 1.4°K. The shifts to shorter wavelengths below the Neel temperature are in agreement with the magnetization data (Abstr. 7558/1954). The changes in intensity can be qualitatively explained for the bromide but the results for the chloride are anomalous. D.J.Oliver

535.343

4446. LINE WIDTH IN THE VIBRATION—ROTATION SPECTRA OF HCl AND CH_4. VARIATION WITH PRESSURE. M.Cameo.
J. Phys. Radium, Vol. 19, No. 8-9, 688-93 (Aug.-Sept., 1958). In French.

An indirect method for measuring the line widths, in the vibration–rotation molecular spectra, was applied to HCl and CH_4, from measurements on a Perkin-Elmer spectrograph 12 C and LiF prism. After establishing formulae for calculation, verification of their validity and a study of pressure broadening, the author gives (1) a study of line-width dependence with rotational quantum number for the fundamental band of HCl, the experimental curve obtained corresponding with theory; (2) measurements of line widths +9 and +10 of the CH_4 ν_3 band.

535.343 : 537.311.33

THE CONTRIBUTION OF FREE HOLES TO THE INFRARED ABSORPTION IN GERMANIUM. See Abstr. 3468

535.343

4447. CONTRIBUTION TO THE STUDY OF DISPERSION IN THE INFRARED ABSORPTION BANDS OF HYDROGEN CHLORIDE.
F.Legay.
Cahiers de Phys., Vol. 11, 383-421 (Oct.-Nov., 1957). In French.

An equation for refractive index is developed using the dispersion theory of Kramers and Heisenberg. The theory of rotation—vibration bands is developed using various potential functions and types of interaction, and the appropriate parameters inserted. Measurements are to be made using a Michelson interferometer with a 25 cm gas cell in one beam and a grating spectrometer. The number of fringes passing during a finite pressure change is to be counted. Sources of error are considered, including effects of absorption, finite slit width and finite resolution. For results and bibliography see following abstract. G.F.Lothian

535.343

4448. CONTRIBUTION TO THE STUDY OF DISPERSION IN THE INFRARED ABSORPTION BANDS OF HYDROGEN CHLORIDE.
F.Legay.
Cahiers de Phys., Vol. 12, 8-39 (Jan., 1958). In French.

Refractive indices are measured as described in preceding abstract; intermediate values are obtained by means of channelled spectra. The dispersion curve is compared with the theory. The results are used to calculate (1) the total intensity of a band, which is compared with other such measurements, and (2) the variation of dipole moment with internuclear distance. Some divergence between experiment and theory may be due to departure of the dispersion curve from the Kramers formula. G.F.Lothian

535.343

4449. INFRARED PROPERTIES OF HEXAGONAL SILICON CARBIDE. W.G.Spitzer, D.Kleinman and D.Walsh.
Phys. Rev., Vol. 113, No. 1, 127-32 (Jan. 1, 1959).

Infrared transmission and reflectivity measurements from 1 to 25 μ (microns) have been made on several samples of green alpha (hexagonal) SiC. The residual ray bands have been observed for the ordinary and extraordinary rays. The resonance frequencies are 2.380×10^{13} sec^{-1} (12.60 μ) and 2.356×10^{13} sec^{-1} (12.73 μ), respectively. From the reflectivity the high-frequency dielectric constant is found to be 6.7. A careful analysis shows that the residual ray bands can be fitted within experimental error by the classical dispersion theory with the correct choice of the dispersion parameters. From the parameters the value 10.0 is obtained for the low-frequency dielectric constant. The effective charge is 0.94e. Complete description of the residual ray band for the extraordinary ray required, in addition to the main resonance, a weak resonance at 2.647×10^{13} sec^{-1} (11.33 μ). A study on the effects of several different surface treatments shows the reflectivities reported here are an intrinsic property of the crystal. The room-temperature absorption coefficient as a function of wavelength in the range 1 to 10 μ has been determined from transmission measurements. A number of weak lattice bands are observed between 5 and 10 μ.

535.343

4450. INFRARED PROPERTIES OF CUBIC SILICON CARBIDE FILMS. W.G.Spitzer, D.A.Kleinman and C.J.Frosch.
Phys. Rev., Vol. 113, No. 1, 133-6 (Jan. 1, 1959).

Films of cubic silicon carbide were grown by the reaction of methane with a high purity silicon surface at 1300°C. Windows of SiC were produced by etching away portions of the silicon. Transmission and reflection measurements in the range 1 to 15 μ were carefully analysed according to classical dispersion theory. The dispersion parameters were determined for the fundamental resonance at 12.60 μ. The dispersion parameters are essentially the same as those for the ordinary ray in the hexagonal α-II form (see preceding abstract).

535.343 : 539

4451. THEORY OF THE INFRARED INTENSITIES OF THE FUNDAMENTAL VIBRATION-ROTATION BANDS.
J.Fernández Biarge, J.Morcillo and J.Herranz.
An. Real Soc. Espan. Fis. Quim., Vol. 52(A), No. 7-8, 181-92 (July-Aug., 1956). In Spanish.

A rigorous treatment of the intensities is given for the general case of polyatomic molecules, assuming mechanic and electric harmonicity. The correct frequency variation is considered in summing the intensity over the rotational components. The final formula expresses the absolute intensity of the k-th vibrational ban in terms of the rate of change of the total molecular dipole moment with the k-th normal coordinate, and of the ratio of two suitably defined frequencies. L.Pincherl

535.34

4452. THE FAR INFRARED ABSORPTION OF SULFIDES, SELENIDES AND TELLURIDES OF ZINC AND CADMIUM.
A.Mitsuishi, H.Yoshinaga and S.Fujita.
J. Phys. Soc. Japan, Vol. 13, No. 10, 1235-6 (Oct., 1958).

The powdered materials were suspended in a polythene film. Each showed one absorption band ranging from 300 cm^{-1} for ZnS to 150 cm^{-1} for CdTe. G.F.Lothian

535.34

4453. THE FAR INFRARED ABSORPTION OF FERRITES.
A.Mitsuishi, H.Yoshinaga and S.Fujita.
J. Phys. Soc. Japan, Vol. 13, No. 10, 1236-7 (Oct., 1958).

Curves of transmission and absorption for the range 500-10 cm^{-1} are given for $ZnFe_2O_4$, $NiFe_2O_4$, $CoFe_2O_4$ and $MgFe_2O_4$ The absorption bands are compared with the bands of Waldron (Abstr. 231/1956); no ν_4 band could be found. G.F.Lothia

535.343 : 539.1

RADIO-FREQUENCY SPECTRA OF HYDROGEN DEUTERIDE IN STRONG MAGNETIC FIELDS. See Abstr. 3996

535.34

4454. ACTION OF ALUMINIUM AND BORON IMPURITIES ON THE OPTICAL ABSORPTION OF VITREOUS GERMANIUM DIOXIDE
V.Garino-Canina.
C.R. Acad. Sci. (Paris), Vol. 247, No. 6, 643-6 (Aug. 11, 1958). In French.

Pure vitreous GeO_2 has two absorption bands, at 2450 A and 2050 A. Aluminium or boron impurity bleaches the 2450 A band without affecting that at 2050 A. The effect is interpreted on the basis of Al replacing Ge at the centres of GeO_4 tetrahedra. B.T.M.Willis

535.345 : 535.39

4455. MEASUREMENT OF THE REFLECTING POWER, THE OPTICAL ABSORPTION AND THE SPECTRAL RESPONSE OF PHOTOCONDUCTING LAYERS. CASE OF OXIDIZED LEAD SULPHIDE. V.Schwetzoff.
C.R. Acad. Sci. (Paris), Vol. 247, No. 23, 2117-19 (Dec. 10, 1958). In French.

Two methods are proposed, called the "method of comparison of indices" and the "reflector method", for measuring the reflecting power, the absorption and the spectral response as a function of the wavelength absorbed. They are applied to polycrystalline PbS, evaporated in vacuo and then oxidized. B.T.M.Willis

535.345 : 535.412

4456. INTERFERENCE FRINGES IN THE ABSORPTION SPECTRA OF EVAPORATED METALLIC LAYERS. H.Schmidt.
Exper. Tech. der Phys., Vol. 6, No. 4, 156-76 (1958). In German.

Interference effects are found in absorption of light passing through an inhomogeneous metal layer on a plate held before the slit of a spectrograph. The fringe characteristics are determined by the density distribution on the film and by the slit width. Various sources of the fringes are excluded. Experiments are reported for Au, Ag and Al. The origin of the fringes is discussed theoretically. S.Tolansky

535.345

4457. THE EFFECT OF PRESSURE ON THE ABSORPTION EDGE IN SILVER HALIDES. T.E.Slykhouse and H.G.Drickamer.
J. Phys. Chem. Solids, Vol. 7, No. 2-3, 207-9 (Nov., 1958).

The absorption edge of AgCl, AgBr and AgI was measured to over 200 000 atmospheres. The behaviour of AgCl and AgBr is quite similar with pressure. There is a small red shift in the low pressure (f.c.c.) phase, a transition at 87 000 (83 000) atmospheres, probably to the simple cubic phase, accompanied by a large red shift, and a further small red shift, at higher pressures. The behaviour of AgI is quite different. The atmospheric (wurtzite) phase transforms to the f.c.c. at 2900 atmospheres with a large red shift. The f.c.c. shifts red very strongly with pressure to 112 000 atmospheres, where there is a second phase change accompanied by a large blue shift. There is a further small red shift at high pressures. A peak which appears at 423 $m\mu$ (428 $m\mu$) in AgI at atmospheric pressure has been attributed by Seitz to a forbidden internal transition in the Ag^+ ion, which is permitted by the symmetry of the wurtzite lattice. The peak disappears in the high pressure phase, which is consistent with Seitz' theory.

535.345 : 537.311.33

4458. INFRARED ABSORPTION BY CONDUCTION ELECTRONS IN GERMANIUM. H.J.G.Meyer.
Phys. Rev., Vol. 112, No. 2, 298-308 (Oct. 15, 1958).

A quantum mechanical theory of infrared absorption by conduction electrons in germanium due to intravalley lattice scattering is developed which takes into account the multivalley structure of the conduction band as well as the present knowledge about intravalley lattice scattering. Within the framework of the deformation-potential theory the calculation can be performed without any serious approximation for all relevant wavelengths and all relevant temperatures. The final result for the absorption constant due to scattering by acoustical modes contains the two deformation-potential constants and may be of help for their quantitative determination. If their numerical values as known at present are used for the numerical evaluation of the absorption constant at $\lambda = 10^{-3}$ cm and $T = 78^{\circ}K$, the result is too low by a factor of about 5 as compared with the experimental result of Fan and Spitzer. If this discrepancy is ascribed to the influence of the optical modes, an estimate may be made of the strength of the coupling of a conduction electron to these modes. On the basis of a simpler model, impurity scattering is also considered and regions of impurity concentration, wavelength, and temperature are indicated where impurity scattering may be neglected. Besides the determination of the deformation potential constants, the theory may be useful for the exploration of the band structure and the various scattering mechanisms and also for the study of impurity-band-conduction phenomena. The general limits of validity of the theory are indicated.

535.345 : 537.312.5

4459. OPTICAL ABSORPTION AND PHOTOCONDUCTIVITY IN MAGNESIUM OXIDE CRYSTALS. W.T.Peria.
Phys. Rev., Vol. 112, No. 2, 423-33 (Oct. 15, 1958).

Optical absorption and photoconductivity spectra of magnesium oxide crystals from various sources are presented. The effects of ultraviolet and X-ray irradiation are described, and the results are interpreted in terms of valence changes of impurities, principally iron. A method for the analysis of the photoconductivity data is given. This method corrects for the effects of strong non-ionizing absorption, which may lead to spurious peaks in photoconductivity spectra. The sign of the optically excited charge carriers was deduced by a method which involves the formation of a space-charge field by the motion of carriers in an applied electric field, and the detection of the asymmetry in this space-charge field when carriers are subsequently allowed to move under the influence of the space-charge field only. A band centred at 5.05 eV has been detected in all specimens measured and this is believed to be due to the impurity Fe^{2+}. Irradiation in this band provides free electrons some of which are believed to be trapped by other Fe^{2+} ions. Three absorption bands previously observed by other authors are believed to be associated with the impurity Fe^{3+}.

535.345 : 537.312.5

PHOTOEMISSIVE, PHOTOCONDUCTIVE, AND OPTICAL ABSORPTION STUDIES OF ALKALI-ANTIMONY COMPOUNDS.
See Abstr. 3504

535.345.6

4460. CHRISTIANSEN FILTERS AND THEIR APPLICATION TO THE DETERMINATION OF THE REFRACTIVE INDICES OF SOLIDS AND LIQUIDS IN THE INFRARED. A.Jeramec.
C.R. Acad. Sci. (Paris), Vol. 247, No. 21, 1846-8 (Nov. 24, 1958).
In French.

Discusses the position, height and width of the transmission maximum as a function of particle size, temperature, and the gradients $dn/d\lambda$ of the refractive index–wavelength curves. If n for the liquid is measured interferometrically, then n for the solid can be determined. G.F.Lothian

535.345.6

4461. ACCURACY OF POLARIZATION FILTERS.
E.Diederichs.
Optik, Vol. 15, No. 1, 35-42 (Jan., 1958). In German.

Possible sources of error were investigated both mathematically and experimentally. The main source of error turned out to be the double refraction in the cover glasses, but, with suitable precautions, this may practically be eliminated.

535.347 : 535.371

4462. DICHROISM AND LUMINESCENCE POLARIZATION IN STRAINED POLYVINYL ALCOHOL FILMS.
W.Hanle, K.Kleinpoppen and A.Scharmann.
Z. Naturforsch., Vol. 13a, No. 2, 64-72 (Feb., 1958). In German.

From luminescence polarization the amount of orientation in the amorphous region of the foil is measured. Better orientation is obtained under moist conditions. X-ray measurement shows that the orientation in amorphous and crystalline regions is similar. Electron microscope surface studies show tear-like clefts perpendicular to the stretching direction corresponding to diffuse regions under a light microscope. Dichroism is studied in the infrared region. G.F.J.Garlick

535.37 : 537.312.5

4463. LOW-TEMPERATURE LUMINESCENCE AND PHOTOCONDUCTIVITY OF AgCl. D.A.Wiegand.
Phys. Rev., Vol. 113, No. 1, 52-62 (Jan. 1, 1959).

The magnitudes and the decay processes of the luminescence and the photoconductivity of AgCl were simultaneously investigated between 4 and $210^{\circ}K$. The decrease of the luminescence intensity with increasing temperature can be attributed to a competing recombination process, not accompanied by visible radiation, and having a thermal activation energy of $E = 0.05$ eV. The decay times are not monotonic functions of temperature, but show maxima. These maxima can be explained in terms of a model in which energy is transported from the site of absorption to the luminescence centre by mobile holes and electrons. Delay in this transport is caused by hole and electron trapping, and temperature dependence of the delay determines the temperature dependence of the decay times. Decay curves calculated on the basis of this model are in qualitative agreement with the observed data. The relative magnitudes of the luminescence and photocurrent decay times and the dependence of the decay and rise times on annealing indicate that if the major portion of the photoconductivity is due to electron motion, then luminescence occurs when holes are captured. It is suggested that this recombination occurs at silver ion vacancies.

535.37

4464. ON THE THEORY OF GLOW CURVES.
K.W.Böer, S.Oberländer and J.Voigt.
Z. Naturforsch., Vol. 13a, No. 7, 544-7 (July, 1958). In German.

An analytical study of solid-state afterglows (phosphorescence) involving the mean lives of the energy states concerned. Reference to the early work of Randall and Wilkins is made in some detail. Trapping centre effects are discussed. J.D.Craggs

535.371

4465. THE DEPENDENCE OF THE DECAY OF LUMINESCENCE ON THE SURFACE CONCENTRATION OF THE SAMPLE. I.Soudek.
Czech. J. Phys., Vol. 8, No. 3, 332-5 (1958). In Russian.

The decay of luminescence was measured of zinc–cadmium sulphide films of varying thickness after ultraviolet excitation. The films were sprayed on to a layer of nitrocellulose lacquer on a glass plate. The phosphor contained 49% ZnS, 51% CdS, 10^{-4} Ag as an activator and of the order of 10^{-6} Cu as an impurity. The surface concentration of the phosphor was determined by weighing the sample, washed from the glass. The average thickness was calculated from the density of the phosphor. Two of the films were not continuous. There is a slight difference between the initial intensities of the thicker films, only a thinner distribution of the crystals causing a more marked decrease. The time dependence of the logarithm of the intensity of decay was plotted. The relative (and to a certain extent also the absolute) difference between the values of the various curves increases with time. Qualitatively the same dependences were observed on zinc–cadmium sulphides activated by copper. The results of these measurements can be interpreted as follows: a certain interaction between the crystals supports the intensity of decay and this interaction decreases with increasing distance between the crystals. This interaction can be either optical or electronic; the fact that the distance between the crystals in continuous films is of the same order as the mean free path of the electron in air speaks for electronic interaction.

535.371 : 620.179.1

4466. NEW TECHNIQUES IN LOW LEVEL FLUOROSCOPY.

B.R.Linden.

I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 104-9 (Dec., 1958).

Outlines the principles on which fluoroscopic image intensifiers work, and considers their requirements and limitations. The devices considered are: (1) solid-state intensifiers; (2) image-convertor tube intensifiers; (3) television camera tubes directly sensitive to X-radiation; (4) television camera systems with enhanced light sensitivity. Some general conclusions are drawn concerning the present state of the art in these devices.

535.371 : 537.312.5

THE INTENSITY-DEPENDENCE OF PHOTOCONDUCTION AND LUMINESCENCE OF PHOTOCONDUCTORS IN THE STATIONARY STATE. See Abstr. 3502

535.371 : 778.344

APPLICATION OF INORGANIC PHOSPHORS TO INFRARED PHOTOGRAPHY. See Abstr. 4195

535.371 : 535.347

LUMINESCENCE POLARIZATION IN STRAINED POLYVINYL ALCOHOL FILMS. See Abstr. 4462

535.372

4467. THE DEPENDENCE OF THE SPECTRAL COMPOSITION OF THE LUMINESCENCE OF ZINC–CADMIUM SULPHIDES ON THE EXCITATION INTENSITY. I.Soudek.

Czech. J. Phys., Vol. 8, No. 3, 336-40 (1958).

A shift of the emission bands to longer wavelengths for an increase in the excitation intensity was observed. This phenomenon can be explained by the migration of holes on the assumption of statistical dispersion between the energy levels of the luminescent centres.

535.372

4468. SULFUR VACANCY MECHANISM IN PURE CdS.

A.A.Vuylsteke and Y.T.Sihvonen.

Phys. Rev., Vol. 113, No. 1, 40-2 (Jan. 1, 1959).

Experiments have been performed on the luminescence of spectrographically pure CdS under ultraviolet excitation at room temperature. Both green and red emissions are observed. The green emission at 5240 A (2.38 eV) is attributed to direct recombination. The red emission at 7180 A (1.72 eV) is described in terms of a phenomenological model proposed by Lambe and Klick. The variations in luminescent intensity of the green and red bands and simultaneously in the photoconductivity of the crystals can be very adequately described if the 7180 A luminescence is attributed to the presence of sulphur vacancies.

535.373 : 534.39

4469. ON THE STIMULATION EFFECT OF SLOWLY DECAYING PHOSPHORS IN THE ULTRASONIC FIELD.

A.Eckardt and K.Nitzsche.

Exper. Tech. der Phys., Vol. 2, No. 1, 1-17 (Jan., 1954). In German.

Screens of ZnS:Cu on a celluloid base were subjected to a closely controlled cycle of excitation to steady luminescence, brief decay, and stimulation (Ausleuchten) by the energy from a 250 W ultrasonic generator applied through a liquid. Alternatively the screen could be stimulated thermally. A variety of screen thicknesses and binder contents was used, and for each the temperature and light output changes with time were recorded automatically. The acoustic stimulation was considered to be purely thermal, but preferential absorption by the crystal grains caused their temperature to be above that recorded for the screen as a whole. Hence the acoustic process, which was independent of the frequency used (1.4 or 4.2 Mc/s), showed a steeper rise of brightness v. measured screen temperature than did thermal stimulation. Data are also presented for the time rate of rise of light emission, and for the rise of emission v. power input, which was nearly linear with a threshold at 0.5 W/cm^2. Numerous photographs are given of objects made visible on phosphor screens by transmitted ultrasound. Practical applications of this technique are considered, including the spraying of a phosphor suspension directly on the surface of the plastic or metal object whose external or internal structure is to be recorded. The image, normally dark against a bright background, is reversed after stopping the ultra-sound. (See Abstr. 7824/1950 and 219/1951).

S.T.Henderson

535.376 : 539.12

4470. THE LUMINESCENCE EXCITATION EFFECT OF α-PARTICLES OF DIFFERENT ENERGIES ON ACTIVATED ZINC SULPHIDE. H.Ortmann.

Exper. Tech. der Phys., Vol. 4, No. 6, 275-8 (1956). In German.

The photo-yield produced by α-particles from copper activated zinc sulphide is found to be dependent on the energy range of the α-particles employed.

H.H.Hodgs

535.37

4471. HEAVY ELEMENTS IN PLASTIC SCINTILLATORS.

M.Hyman, Jr and J.J.Ryan.

I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 87-90 (Dec., 1958).

Studies the possibilities of incorporating into plastic scintillators substantial quantities of heavy element compounds without the introduction of appreciable colour or haze. Factors governing the quenching of the light output are considered, and a practical balanc is struck between lowered pulse height and the quantity of heavy element introduced. The various components required in a heavy-element-loaded plastic scintillator are outlined, with a discussion o the effects of variations in their chemical character and proportion Specific approaches to the problem are outlined as follows: (1) the inclusion in the plastic scintillator or organo-metallic compounds; (2) inclusion of essentially non-ionic metal salts; (3) inclusion of chelated metal compounds; (4) use of a base plastic material in which a variety of metal compounds are more soluble than in the standard vinyl-aromatic type of base plastic; and (5) inclusion of a metal compound that is also a monomer. Possible applications to detection of low energy radiation and of thermal neutrons are discu sed.

535.376

4472. FUNDAMENTAL STUDIES OF SCINTILLATION PHENOMENA IN NaI. W.J.Van Sciver and L.Bogart.

I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 90-2 (Dec., 1958).

Previous work on pure NaI has been extended using crystals of higher purity at temperatures down to 4°K. Decay of the light pulse from unactivated NaI is not a simple exponential, but exhibits a rising component superimposed on an exponential decay. In other measurements, the absolute conversion efficiency (emitted useful light divided by exciting particle energy) was found to be as high as 25% for unactivated NaI at liquid nitrogen temperature (compared with 13% for NaI:Tl at room temperature). Theoretical and practical implications of the results are discussed.

535.376

4473. GLASS SCINTILLATORS. R.J.Ginther and J.H.Schulman.

I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 92-5 (Dec., 1958).

The most efficient material investigated to date is a cerium-activated high-silica glass. The pulse height of this material has been found to be as high as 10 per cent that of NaI(Tl), but its efficiency is dependent upon the purity of the high silica glass from whic it is prepared. Conventional meltable glasses activated with cerium have been prepared which have a pulse height of 7 per cent of NaI(T The pulse height of these meltable glasses is dependent upon their composition. Alkaline earths have been found to be deleterious, whereas the presence of aluminum has been found to be beneficial. The most efficient composition to date has been found to be $1.0Na_2O$, $0.03Ce_2O_3$, 3.0-$4.0(B_2O_3 + SiO_2)$, 1.0-$1.3Al_2O_3$. Methods of preparation of both meltable and high silica glass type glasses, as well as their optical properties, are described.

535.376

4474. DECAY TIMES OF SCINTILLATORS.

R.K.Swank, H.B.Phillips, W.L.Buck and L.J.Basile.

I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 183-7 (Dec., 1958).

An apparatus has been constructed in which cathode-rays are used to excite the scintillator. Cathode-ray pulses as short as 10^{-10} sec are generated by sweeping a cathode-ray beam across a narrow slit. The emergent electrons in the pulse are accelerated to $\sim$ 80 keV and pass through a thin window to strike the scintillator. The latter may be a crystal, plastic or liquid. The light from the scintillator is detected and amplified by a multiplier phototube, type 1P28. The currents from the anode and last dynode are fed through 120 ohm transmission lines to a travelling-wave oscilloscope. A value of 2.15×10^{-9} sec is obtained for the decay time of scintillations from a solution of 5 g/l of terphenyl in toluene, in agreement with the previous measurements. The apparatus is currently being used to study the dependence of the decay time on solute concentration in liquid and plastic scintillators. The decay time is found to increase with decreasing concentration, as predicted by the current theories of energy transfer. A description of the apparatus and some of the results are presented.

535.376 : 537.533.75

LUMINESCENCE PHOTOMETRY MEASUREMENTS OF THE ENERGY ABSORPTION IN THE RADIATION FIELD OF ELECTRON SOURCES. ONE DIMENSIONAL CASE IN AIR. See Abstr. 3574

535.376 : 539.1.07

4475. FURTHER WORK WITH NOBLE ELEMENT SCINTILLATORS. J.A.Northrop, J.M.Gursky and A.E.Johnsrud.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 81-7 (Dec., 1958).

An investigation of the relative scintillation efficiencies of the various noble gas mixtures was made in an attempt to find a combination that would yield either more light than any of the pure gases or allow a more economical use of the heavier gases without substantial loss of light. Data on the efficiency of all binary mixtures of Xe, Kr, A, Ne, and He are presented. They show a characteristic large drop in the light for mixtures containing a small proportion of the heavier gas in a major fraction of the lighter. However, a 10% Xe—90% He mixture has a relatively large output and could be useful in constructing a high-efficiency neutron counter using the $He^3(n,p)H^3$ reaction. Data are also presented on the relative conversion efficiencies of several commonly used organic waveshifters. Of those tested, the best are diphenyl stilbene, tetraphenylbutadiene, and quaterphenyl having relative efficiencies of 1.0, 0.7 and 0.4, respectively. A survey investigation was also made of the relative efficiencies of solid and liquid xenon, krypton, and argon for ordinary glass and for quartz-faced photomultipliers. Although these data are not as accurate or reproducible as the corresponding work on gases, they indicate several of the combinations may approach NaI(Tl) in light output.

535.376 : 539.1.07

4476. THE DECAY TIMES OF ORGANIC SCINTILLATORS AND THEIR APPLICATION TO THE DISCRIMINATION BETWEEN PARTICLES OF DIFFERING SPECIFIC IONIZATION. R.B.Owen.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 198-201 (Dec., 1958).

Studies of the differences in the decay time of organic phosphors have shown that, while most of the light is emitted with a short-period fluorescence decay, differences in specific ionization affect the long-term components. It is consequently possible to distinguish between gamma-ray and neutron excitation of many phosphors (including scintillating liquids) by using multiplier photocells having relatively slow response characteristics. Photomultipliers with large-area photocathodes can therefore be used.

535.376 : 536.58

4477. THE SHARE OF THERMAL ENERGY TAKEN FROM THE SURROUNDINGS IN THE ELECTRO-LUMINESCENT ENERGY RADIATED FROM A P—N JUNCTION. J.Tauc.
Czech. J. Phys., Vol. 7, No. 3, 275-6 (1957).

It is shown that a part of the energy radiated during electroluminescence produced by the passage of current in the forward direction in a p—n junction is taken from the surroundings in the form of heat. The possibility of using this phenomenon for cooling purposes is considered.

535.376

4478. ELECTROLUMINESCENCE AT HIGHER EXCITATION FREQUENCIES. R.Lochinger.
Scientia Electrica, Vol. 4, No. 4, 109-20 (1958). In German.

Experiments are described on electroluminescent cells operated over a range of frequencies, mostly 20 to 200 kc/s. Curves show the resultant variations of measured capacitance and resistance of the cells, their light output v. voltage relations, and the changes in spectral emission with frequency. An equivalent circuit is derived. The light output reaches a peak at 16 kc/s and declines to a very low value at 200 kc/s. Computations are made of the amount of power dissipated as heat and light respectively. The efficiency of power conversion to light falls from ~ 50% at 20 kc/s to ~ 10% at 120 kc/s and is near zero above 200 kc/s. S.T.Henderson

535.377 : 550.9

4479. MEASUREMENTS OF THERMOLUMINESCENCE AS A MEANS OF INVESTIGATING THE THERMAL AND RADIATION HISTORY OF NATURAL MINERALS AND ROCKS.
F.G.Houtermans, E.Jäger, M.Schön and H.Stauffer.
Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 283-92 (1957). In German.

The materials were tested as powders stuck on to a thin steel strip and heated at 60 deg/sec up to 500°C. The resolution of the glow curves was not much affected by this rapid heating. Curves are shown for artificially irradiated fluorspar and other minerals which in general have one or two thermal peaks between 20 and 250°C as well as one at 300-400°C, while the natural minerals show only the high temperature peak. The dose of radiation received by the mineral can be estimated, hence its age if the ambient radioactivity is known. For stone meteorites somewhat different comparisons arise between natural and irradiated samples. The effects of cosmic radiation are discussed. The residual peaks in the glow curve suggest the maximum temperature suffered by the meteorite. S.T.Henderson

535.393

4480. ON THE POSSIBLE INFLUENCE OF ELECTRON INTERACTION ON THE REFLECTIVITY OF METALS. C.W.Benthem.
Appl. sci. Res. B, Vol. 7, No. 4, 275-92 (1958).

The influence of the electron viscosity (see Abstr. 7434/1954) on the absorption factor of metals in the infrared is further investigated. The superposition of the previous description and the anomalous skin effect leads to a paradoxical result, so that the electron viscosity model is replaced here by a relaxation time model. This new description leads to an integro-differential equation of the Wiener—Hopf type, which is solved, the previous difficulties disappearing.

535.393

4481. VARIATION OF THE OPTICAL PROPERTIES OF A THIN LAYER OF GOLD AS A FUNCTION OF THE WAVELENGTH.
R.Philip.
C.R.Acad. Sci. (Paris), Vol. 247, No. 25, 2322-4 (Dec. 22, 1958).
In French.

The variation in the wavelength range from 2447 to 6438 A was determined for the following quantities: coefficients of reflection, transmission and absorption; phase changes at gold—air and gold—quartz interfaces; and optical constants, n and k. B.T.M.Willis

535.393

4482. A REMARK ON THE REFLECTION OF LIGHT FROM A METAL WITH A THIN INTERFERING NON-METALLIC FILM.
A.Vašíček.
Czech. J. Phys., Vol. 8, No. 3, 296-300 (1958).

The theory of reflection of light from a thin film on a metal is applied to thin films of aluminium oxide produced on aluminium by anodization. Interference within the film is taken into consideration and the predictions from this interference theory fit closely to some earlier experimental results reported twenty-three years ago by Tronstad and Höverstad. S.Tolansky

535.393

4483. OPTICAL PROPERTIES OF THIN FILMS OF Al, Ag AND Cu IN INFRARED REGION. K.Kudo and S.Takezawa.
Sci. of Light (Tokyo), Vol. 6, No. 1, 1 8 (March, 1957).

Reflecting and transmission coefficients are determined for evaporated thin films of Al, Ag and Cu in the region 1 to 15 μ. Film thickness ranges from 40 to 460 A. Extinction coefficients are calculated. For infrared reflecting mirrors film thickness should exceed 500 A. Critical thickness values are given for the three metals. Absorption maxima are at about 100 A. S.Tolansky

535.4 : 535.892

MICROCOMPARATOR ILLUMINATION SYSTEM FOR IMPROVED RESOLUTION OF RAYLEIGH DIFFUSIOMETER DIAGRAMS. See Abstr. 3372

535.417

4484. INVESTIGATION INTO INTERFERENCE PHENOMENA AT EXTREMELY LOW LIGHT INTENSITIES BY MEANS OF A LARGE MICHELSON INTERFEROMETER. L.Jánossy and Z.Náray.
Nuovo Cimento Suppl., Vol. 9, No. 2, 588-98 (1958).

Interference phenomena are carried out with very weak sources with a Michelson interferometer of very long armlength (13.85 m). The weak sources were observed with a photon counter technique. It is concluded the interference phenomena are perfectly normal even at such low intensities where at one time on the average, less than one photon is to be found in the apparatus. This is true even if the dimensions of the apparatus greatly exceed the coherence length of the photons producing the interference pattern. S.Tolansky

535.42 : 534.321.9

4485. THE DIFFRACTION OF LIGHT BY SUPERPOSED PARALLEL SUPERSONIC WAVES. GENERAL THEORY.
R.Mertens.
Proc. Indian Acad. Sci. A., Vol. 148, No. 5, 288-304 (Nov., 1958).

A system of difference differential equations is developed for the diffracted amplitudes from a normally incident collimated scalar disturbance. Explicit solutions are obtained in certain cases. The dependence of the symmetry properties of the spectra on the frequency ratio between the supersonic waves is shown.
W.T.Welford

535.42

4486. A SIMPLE METHOD OF CALCULATING MOIRÉ PATTERNS. G.L.Rogers.
Proc. Phys. Soc., Vol. 73, Pt 1, 142-4 (Jan., 1959).

The calculation is done by means of simple relations between the reciprocal-space transform of the moiré pattern and the transforms of the two grating patterns. A.R.Stokes

535.42

4487. THE USE OF DIRAC FUNCTIONS IN TWO DIMENSIONAL SPECTRAL ANALYSIS. J.Isabeau.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 42, No. 8, 840-53 (1956). In French.

A general discussion of the one- and two-dimensional Dirac functions is given and the latter is applied to explain the phenomenon of "moirage". This is the phenomenon of apparent modulation of thread thickness or colour which is observed in materials such as watered silk (moiré). Similar modulation is observed with fine wire grids or in rasters on television screens. G.D.Sims

535.421

4488. PRODUCTION OF REPLICA GRATINGS. I.
M.Seya and K.Goto.
Sci. of Light (Tokyo), Vol. 5, No. 2, 46-8 (Sept., 1956).

Little has been written of the practical details of making grating replicas by stripping off vacuum evaporated aluminium films. The authors give full details of their method, which not only gives good replicas, but allows one replica to be used to make the next. A comparison is given of spectra produced by an original grating and a fifth replica. R.W.Fish

535.421 : 531.715

4489. PRECISION MEASUREMENT OF THE GRATING CONSTANT OF A CONCAVE GRATING. W.Bartholomeyczyk.
Z. InstrumKde, Vol. 66, No. 3, 43-7 (March, 1958). In German.

The distance between a counted set of rulings was determined on a length comparator. A precision of 5 in 10^6 in the grating spacing was obtained. W.T.Welford

535.434

4490. SCATTERING OF LIGHT BY SPHERICAL PARTICLES. I.
N.Mori and H.Kikuchi.
Bull. Electrotech. Lab. (Tokyo), Vol. 21, No. 8, 561-7 (Aug., 1957). In Japanese.

The intensities I_1, I_2 and comples amplitudes Σ_1, Σ_2 of light scattered by spherical particles of refractive index 1.33 were computed on Mie's theory as $x = 2\pi R_0/\lambda = 5.5 - 10.0$ (0.5 per step) and $\gamma = 0 - 180^0$ (5^0 per step) by using A_n, P_n, π_n, and τ_n published by Gucker (P.B. Report 107016, 1950).

535.434

4491. SCATTERING OF LIGHT BY SPHERICAL PARTICLES. II.
N.Mori and H.Kikuchi.
Bull. Electrotech. Lab. (Tokyo), Vol. 22, No. 3, 209-24 (March, 1958). In Japanese.

The intensities I_1, I_2 and complex amplitudes Σ_1, Σ_2 of light scattered by spherical particles of refractive index 1.33 were computed on Mie's theory as $x = 2\pi R_0/\lambda^{(0)} = 10.0 - 18.5$ (24 points) and $\gamma = 0 - 180^0$ (2.5^0 per step). They are computed with the Automatic Relay Computer ETL Mark II, by using An and Pn, with some corrections, published by Gucker (P.B. Report 1070116, 1950) and τ_n and π_n published by Gucker and Cohn (J. Colloid Sci. 8, 555, 1953).

535.435

4492. THEORETICAL AND EXPERIMENTAL STUDY OF THE LIGHT SCATTERED BY SOLUTIONS OF CHAIN MACROMOLECULES IN GOOD SOLVENTS. C.Loucheux, G.Weill and H.Benoit.
J. Chim. phys., Vol. 55, No. 7-8, 540-6 (July-Aug., 1958). In French.

The theory of light scattering in solutions given by Debye is extended to solutions of macromolecules in a good solvent. Curves are given which enable the coefficient α in the equation $[\eta] = KM^{\alpha}$ to be found. This equation expresses the intrinsic viscosity $[\eta]$ as a function of the molecular weight M. In favourable cases it is then possible to determine the polydispersity of the macromolecular solution from a study of the asymptotic behaviour of the parameter which characterizes the angular distribution of the scattered light. The molecular dimensions of the macromolecule can also be found. The method is applied to a sample of polystyrene ($M = 9 \times 10^6$) in benzene and the results compared with those in cyclohexane at 34°C. The experimental verification is satisfactory. H.G.Jerrard

535.514.

4493. ULTRAVIOLET POLARIZERS. Y.Bouriau and J.Lenoble.
Rev. Opt., Vol. 36, No. 11, 531-43 (Nov., 1957). In French.

The different methods of u.v. polarization are reviewed. A study is made of the transparency of various optical cements with a view to making polarizers of the Glazebrook or Nicol type. The cutting angles are given for these polarizers in spar cemented with gedamine; the Nicols that have been made have a reasonable transparency down to 2500 A and a good extinction throughout the spectrum.

535.5

4494. BIREFRINGENCE CHANGES DURING RETRACTION OF ORIENTED POLYSTYRENE MONOFILAMENTS. III. CORRELATIO WITH INTERNAL STRESS CHANGES. J.F.Rudd and R.D.Andrews.
J. appl. Phys., Vol. 29, No. 10, 1421-8 (Oct., 1958).

For Pts I and II, see Abstr. 8716-17 (1956). The changes in average birefringence and internal stress during retraction at 85°C were measured for four different oriented polystyrene monofilamen The data for the different filaments all appear to fall on a single curve when plotted as internal stress v. birefringence. Data on inte nal stress and birefringence obtained for thirteen different oriented filaments (including the four above) in their initial uncontracted stat also fall on the same curve. This is in marked contrast with the lac of correlation obtained in Pt I where it was attempted to relate birefringence to elongation parameters. Evidently birefringence is relate most directly to internal stress rather than elongtaion, and in fact provides a direct measure of the internal stress. This simple relation seems to be essentially independent of the stress-time-temperature history of the samples during orientation. Measurements on an additional filament which has a very nonuniform birefringence distribution (studied also in Pt II) indicate that internal stress should b correlated with area average rather than diameter average birefringence, in cases where such a distinction is necessary. The internal stress-birefringence curve is not linear, contrary to theoretical predictions based on the simple kinetic theory of rubber elasticity. Non-Gaussian chain statistics may explain this nonlinearity. The present results indicate that birefringence provides a more useful index of molecular orientation than measurements of total amount of retraction.

535.55 : 534.39

4495. CRITICAL STUDY OF THE VISUAL MEASUREMENT OF ACOUSTIC BIREFRINGENCE. J.Badoz.
J. Phys. Radium, Vol. 19, No. 6, 590-4 (June, 1958). In French.

Ultrasonic waves in viscous liquids, produce optical anisotropy (Lucas effect). The amplitude of this anisotropy varies with the velocity gradient of the u.s. wave. Ordinary, visual, methods of measurement of birefringence cannot be used. Zvetkov, Mindlina and Makarov proposed a new method in 1946. Sensitivity, precision, accuracy of this method are here theoretically and experimentally studied. Importance of the angle of light rays with u.s. planes and of light diffraction by u.s. waves is pointed out. Sensitivity limit of this method is 3 or 4 x $10^{-4}\lambda$: precision is only 10% when optical path is 3 or 4 x $10^{-3}\lambda$ and 1% or 3 or 4 x $10^{-2}\lambda$. Inavoidable constant errors or bias disturb absolute measurements.

535.56 : 538.613

4496. THE EFFECT OF SATURATION OF THE PARAMAGNETIC RESONANCE ABSORPTION ON THE (OPTICAL) FARADAY EFFECT. H.Wesemeyer and J.M.Daniels.
Z. Phys., Vol. 152, No. 5, 591-8 (1958). In German.

The Faraday effect for the green mercury line is investigated for a neodymium ethyl sulphate crystal ($Nd(C_2H_5SO_4)_3 \cdot 9H_2O$) in a magnetic field of 1800 gauss at 1.4°K. The saturation of the paramagnetic resonance signal of the Nd^{+++} ions with microwave radiation (9060 Mc/s) reduces the magnetic moment and hence the Faraday effect which could in fact be reduced to zero. The change in Faraday effect can be related to the magnetic resonance relaxation times and a formula is derived. The spin lattice relaxation times in this case is $\frac{1}{20}$ sec. J.G.Powles

535.56 : 537.311.33

ON THE FARADAY EFFECT IN SEMI-CONDUCTORS. See Abstr. 3453

535.624

4497. DYE-MIXTURE ANALYSIS WITH AN ELECTRONIC CALCULATING PUNCH. J.L.F.De Kerf.
J. Opt. Soc. Amer., Vol. 48, No. 12, 972-5 (Dec., 1958).

The calculation of the tristimulus specifications of subtractive dye mixtures consists of three parts: the calculation of the spectral density of the mixture, the conversion to the spectral reflectance or transmittance, and the deduction of the tristimulus values and chromaticity coordinates. With a standard IBM 604 electronic calculating punch, three runs are needed and the yield is about 24 to 60 colour points an hour, according the desired accuracy. It is shown that with an expanded type, the 604-004, the complete calculation can be performed in one single run. In this way the yield attained is 60 to 150 colour points an hour.

535.65

4498. PHOTOELECTRIC COLOR DIFFERENCE METER.

R.S.Hunter.
J. Opt. Soc. Amer., Vol. 48, No. 12, 985-95 (Dec., 1958).

The colour difference meter has three photodetectors, each with a separate tristimulus filter, and each receiving some of the light reflected from the specimen. Signals from the photodetectors are measured by analogue circuits that give rectangular coordinates for surface colours in close correspondence to their positions in uniform colour space. The first model described in 1948 uses barrier-layer photocells and three tristimulus filters. Recently, a model employing vacuum phototubes and four filters was built. Use of vacuum phototubes makes it possible to substitute a d.c. amplifier and pivot meter for the suspension galvanometer necessary with barrier-layer photocells. By thermostatting the phototube chamber, excellent stability is obtained. A light pipe in the viewing beam provides a more stable and efficient mixer of light to the different photodetectors than the white-lined sphere used previously.

535.653

4499. COLOR CONSTANCY IN SHADOWS.

S.M.Newhall, R.W.Burnham and R.M.Evans.
J. Opt. Soc. Amer., Vol. 48, No. 12, 976-84 (Dec., 1958).

The purpose of the study was to make evaluations of the colour constancy, both overall and by attributes, of ten colour samples viewed one at a time under the standard shadow. The method was to present the colour samples in the surface mode of appearance and to match them with a colorimeter, the field of which was also perceived in the surface mode. In some trials the shadow was present, in some absent, and in others there was no perceived shadow but rather the sample luminance alone was reduced proportionally. These match data were converted to the Munsell system of renotation. Brunswik-type constancy ratios were formed in terms of Munsell hue, chroma, and value taken separately. The results indicate the constancy of the hue, saturation, and lightness of the surface colour perceptions. There was evidence of considerable constancy in all three attributes. After weighting the data for each attribute in accordance with an appropriate colour difference formula, an estimate of the combined or over-all colour constancy was obtained.

535.653 : 612.843.31

N.P.L. COLOUR-MATCHING INVESTIGATION. See Abstr. 4162

535.7

PHYSIOLOGICAL OPTICS. VISION. See also the Section entitled "BIOPHYSICS. PHYSIOLOGICAL PHYSICS".

535.822.1

4500. A "SOLID IMAGE" MICROSCOPE.

D.M.Mackay; R.L.Gregory and P.E.K.Donaldson.
Nature (London), Vol. 183, 246-7, 247 (Jan. 24, 1959).

The first letter describes a solid-image microscope in which the slide carrier is vibrated in depth, while illuminated by a flying spot scanner. After passage through the microscope, the light is received on a photomultiplier. The image is built up again in a 3-dimensional projective cathode ray tube. The electronic scanner allows a negative picture to be displayed so that small objects are not obscured by a bright background. In the second letter, the authors of Abstr. 2253 (1959) suggest that a similar effect can be obtained by optical means. R.W.Fish

535.822.17

4501. PHASE-CONTRAST METHODS IN TERMS OF OPTICAL TRANSFORMATION THEORY. E.Menzel.

Optik, Vol. 15, No. 8, 460-70 (Aug., 1958). In German.

If the optical path variations in a phase object are small compared to the wavelength, contrast transfer functions can be defined for phase- or interference-contrast imagery. Sources of finite size (partially coherent illumination) and a number of different observing techniques for phase objects are considered. A method of measuring the transfer functions is proposed. W.T.Welford

535.822.3 : 537.534.3

4502. A PHOTOELECTRIC MICROSCOPE FOR MEASURING THE SEPARATION OF MASS SPECTROGRAPH DOUBLETS.

W.Müller-Warmuth.
Z. Naturforsch., Vol. 12a, No. 3, 212-17 (1957). In German.

A precision apparatus is described for the measurement of spectral line separations, which is markedly superior to the usual comparators in ease of use and accuracy. The plate is enlarged 100 times in a projection microscope, so that the lines are readily visible on a matt screen. Alternatively a small part of the field, containing the doublet, is selected and periodically moved across the slit of a photocell by means of a rotating prism. The impulses are amplified and impressed on the vertical plates of a double beam oscillograph, whilst a synchronized saw-tooth deflection is produced by the horizontal plates. By means of a phase-inversion system the signals are fed to the two beams in opposite senses, and adjustments are made until a sharp stationary pattern is obtained. In this way the separation of a doublet can be measured to an accuracy of about 0.1 μ. The method imposes little strain on the eyes and gives good results even with weak and irregular lines. V.E.Cosslett

535.823.9

4503. AN ARRANGEMENT FOR RAPID INTERCHANGE OF SUPPRESSION FILTERS FOR FLUORESCENCE MICROSCOPY RESEARCH. A.Resch.

Z. wiss. Mikr., Vol. 64, No. 1, 49-52 (Nov., 1958). In German.

A simple mechanical improvement for the introduction of filters into a light path in fluorescence microscope is described. S.Tolansky

535.825 : 669

4504. MICROSCOPE ATTACHMENT FOR ACCURATE MICRODRILLING AND THE REMOVAL OF ANALYTICAL SAMPLES FROM SMALL AREAS. A.C.Simon and D.A.Gildner.

Rev. sci. Instrum., Vol. 29, No. 12, 1125-8 (Dec., 1958).

An air-driven microdrilling apparatus is described which can use drills as small as 0.025 mm in diameter. This machine is interchangeable with the usual metallurgical microscope objective and can be adjusted to coincide with the optical axis. An area centred under the cross hair of the ocular can be accurately drilled by replacing the objective with the drilling attachment.

535.825 : 669

4505. RAPID-QUENCHING HOT STAGE FOR METALLOGRAPHY.

G.R.Speich and M.Cohen.
Rev. sci. Instrum., Vol. 29, No. 12. 1129-31 (Dec., 1958).

A microscope hot stage designed for use at temperatures up to 1100°C and for rapid quenching rates up to 500°C/sec is described. The stage is especially suited for the study of reactions in steels where it is often necessary to quench quickly from the austenitizing temperature to some lower transformation temperature. The sample is protected from oxidation by vacuum or an inert atmosphere.

535.89

4506. ON A NEW KIND OF RADIATION SOURCE, THE METAL HIGH PRESSURE LAMP. R.Rompe and A.Ihln.

Abhandl. Dtsch. Akad. Wiss. Berlin Kl. Math. Phys. Tech., 1958, No. 1, 20 pp. In German.

This lamp utilizes an arc discharge between tungsten tipped water cooled copper electrodes in an inert gas at several atmospheres pressure contained within a metal chamber with a quartz window. The stages of development are described. Constructional details and operating characteristics are given together with a short theoretical discussion and a review of some applications. C.E.Williams

535.89 : 534.222.2 : 778.37

4507. HIGH-SPEED MULTIPLE-SPARK LIGHT SOURCE.

M.R.Wilson and R.J.Hiemenz.
Rev. sci. Instrum., Vol. 29, No. 11, 949-51 (Nov., 1958).

A high-speed spark light source is described which can be used in the photographic systems of shock tunnels, shock tubes, and ballistic ranges. The source provides five high-intensity flashes, each with available delays of as low as 0.1 μsec between consecutive sparks. The transmission line principle is used with barium titanate capacitors to obtain a spark discharge time of under 0.1 μsec. Five spark assemblies are mounted in line with a lens system to provide a common point where all spark flashes are brought to focus. The light source is used in conjunction with a high-speed drum camera on which is mounted the recording film.

HEAT

536.2

4508. APPROXIMATE SOLUTION OF EQUATIONS FOR THE THERMAL BOUNDARY LAYER WITH VARIATIONS IN BOUNDARY LAYER STRUCTURE. G.S.Ambrok.
Zh. tekh. Fiz., Vol. 27, No. 9, 2134-42 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 1979-86 (Sept., 1957).

Applicable to various thermal boundary layer structures and for variable surface temperature. The method of calculation recommended is compared with data from experiments on flat plates and on gas turbine profiles.

536.2

4509. COMPARISON BETWEEN THE LINEAR AND NON-LINEAR STEADY-STATE BEHAVIOR OF A HEATED TUBE. B.L.McFarland.
J. appl. Phys., Vol. 29, No. 12, 1682-4 (Dec., 1958).

The range of applicability for the solution of the linearized diffusion equation is discussed for a particular case — heating of a homogeneous tube by internal energy generation. The range is defined by comparisons of series solutions of the linear and non-linear diffusion equations (constant material properties v. variable material properties). Two sources of errors in the constant-property solution are evaluated and a criterion for the limits of applicability of the linear solution is derived.

536.2.01

4510. THERMAL CONDUCTIVITY OF DIELECTRICS AT LOW TEMPERATURE. P.Résibois.
J. Phys. Radium, Vol. 19, No. 10, 776-80 (Oct., 1958). In French.

An objection is raised against Peierls' argument concerning the special role played by umklapp processes in thermal conduction at low temperature: by the very definition of wave vectors, it seems that the quantity $J = \Sigma \hbar f n_f$ is defined only as a reciprocal lattice vector; particular importance can not therefore be given a priori to umklapp processes. Discussing the expression for the thermal flow, it is shown that the condition to obtain a finite thermal conductivity is the existence of three phonon collisions of frequencies ω, ω' and ω'', in which ω' and ω'' remain finite when $\omega \rightarrow 0$; umklapp processes are a particular kind of such processes.

536.212

4511. THE MEASUREMENT OF THE THERMAL CONDUCTIVITY OF SEMICONDUCTORS CLOSE TO ROOM TEMPERATURE. A.V.Ioffe and A.F.Ioffe.
Zh. tekh. Fiz., Vol. 28, No. 11, 2357-63 (1958). In Russian.

The limitations of the apparatus and method described previously (see Abstr. 5992/1953) are examined. For thermal conductivities K between 10^{-3} and 10^{-1} cal/(deg.C cm sec), errors in K should be less than 10%. Several improvements in the apparatus are described or proposed. K.F.Hulme

536.212

4512. A THEORETICAL CONSIDERATION OF THE METHOD OF MEASURING THE THERMAL CONDUCTIVITY OF SEMICONDUCTORS PROPOSED BY A.V.IOFFE AND A.F.IOFFE. M.A.Kaganov.
Zh. tekh. Fiz., Vol. 28, No. 11, 2364-7 (1958). In Russian.

The method is not a steady-state one, and, if the procedure for calculating the thermal conductivity κ from the temperature measurements is to be applicable, the measurements used must be made between the times t_1 and t_2 after the start of heat flow. The permissible values of t_1 and t_2 are derived from the exact solution of the heat conduction equation. For $\kappa = 10^{-3}$ cal/(deg C cm sec) under typical conditions $t_1 = 90$ sec and $t_2 = 400$ sec. K.F.Hulme

536.212

4513. ON THE EFFECT OF THE IMPURITIES GALLIUM AND IRON ON THE THERMAL CONDUCTIVITY OF GERMANIUM. G.B.Abdullaev, G.M.Aliev and N.I.Chetverikov.
Zh. tekh. Fiz., Vol. 28, No. 11, 2368-71 (1958). In Russian.

The thermal conductivities κ of three Ge- and three Fe-doped single crystal Ge specimens were measured at 20°C; on increasing the concentration of impurity atoms from 10^{15} to 5×10^{17} per cm^3, κ decreased from 0.12 to 0.04 cal/(deg C cm sec); the decrease was slightly greater for Ga-doping — due, it was thought, to the larger atomic radius of Ga, and the lower mobility of holes. Using a transverse magnetic field of 9500 Oe to suppress the carrier contribution, κ_c, it was shown that $\kappa_c < 1\%$ to 2.5% of κ, in the range 20°-300°C; κ_c was, however, larger than expected from the Wiedmann—Franz law; the discrepancy was not explicable by the transport of recombination energy by hole—electron pairs. K.F.Hulm

536.212 : 537.311.3

THERMAL RESISTIVITY OF THE TRANSITION ELEMENTS AT LOW TEMPERATURES. See Abstr. 3437

536.22 : 532.517.2

4514. HEAT TRANSFER IN NON-NEWTONIAN LAMINAR FLOW IN TUBES. J.Schenk and J.van Laar.
Appl. sci. Res. A, Vol. 7, No. 6, 449-62 (1958).

A theoretical investigation is presented of the heat transfer from fluids in non-Newtonian laminar flow in circular cylindrical tubes. The velocity profile is introduced according to the Prandtl—Eyring formula. Eigenvalues and eigenfunctions are calculated for some values of the velocity profile parameter b (which is proportio to the longitudinal pressure gradient), and graphs of the cup-mixing mean temperature of the fluid and of the dimensionless local heat transfer coefficients are given. The results are compared with those of some other workers who carried out calculations assuming the Ostwald profile. The influence of the thermal resistance of the tube wall for radial heat flow is also investigated. Formulae are presented concerning the influence of heat dissipation resulting fro internal friction, for the Ostwald profile as well as for the Prandtl—Eyring profile.

536.23 : 545.844

EFFECT OF THE CARRIER GAS ON THE SENSITIVITY OF A THERMAL CONDUCTIVITY DETECTOR IN GAS CHROMATOGRAPH See Abstr. 4096

536.25

4515. FREE-CONVECTIONAL HEAT TRANSFER FROM A SINGLE HORIZONTAL WIRE. S.Arajs and S.Legvold.
J. chem. Phys., Vol. 29, No. 4, 697-9 (Oct., 1958).

Free convectional heat transfer from single, horizontal, heated, 2 and 3 mil platinum wires was measured in gaseous A, N_2, O_2, CO_2 and in liquid $(CH_3)_2CO$, CH_3OH, $C_6H_5CH_3$. The measurements, extending approximately from $GrPr = 1$ to $GrPr = 10^{-5}$, satisfied the Senftleben correlation.

536.25 : 532.5 : 538.3

THERMAL INSTABILITY OF INTERNALLY HEATED FLUID SPHERE IN MAGNETIC FIELD. See Abstr. 3658-60

536.33.08

4516. METALLIC BOLOMETERS IN PERIODICALLY INTERRUPTED RADIATION. R.Novák.
Czech. J. Phys., Vol. 8, No. 2, 196-207 (1958).

A theory is given for the case in which the measured radiation is chopped periodically. The impedance of a bolometer, through which a direct and an alternating current pass simultaneously, is derived. Separate solutions are given for bolometers cooled by heat conduction and bolometers with thermal impedance dependent on the temperature. Expressions are derived for the sensitivity and minimum measurable power and the conditions for the choice of a coupling transformer with optimum ratio. The lowest value of the minimum power measurable by metallic bolometers working in interrupted radiation is determined.

536.33.08

4517. THE THEORY OF METALLIC BOLOMETERS. R.Novák.
Czech. J. Phys., Vol. 7, No. 3, 284-92 (1957).

All the important parameters of metallic bolometers are derived on the assumption that cooling only takes place by conduction through the ambient gas. These parameters are described by means of dimensionless relative quantities which are independent of the dimensions of the bolometer. Generally valid diagrams are given for the dimensionless parameters, from which the properties of an arbitrary metal bolometer can be determined in a simple way. A general expression is derived for the relative sensitivity of a bolometer, containing only the temperature coefficient and the temperature increase of the bolometer above its surroundings.

536.33.08

4518. AN INVESTIGATION OF THE PROPERTIES OF BOLOMETERS MADE BY VACUUM EVAPORATION. K.Yosihara.
Sci. of Light (Tokyo), Vol. 5, No. 2, 29-45 (Sept., 1956).

High resistance bolometers were made by vacuum evaporation of bismuth and tellurium. Measurements of temperature coefficient, noise and frequency response were made. Bismuth was found to be

superior to tellurium, particularly when sensitized with a thin film of gold. Typical results obtained with such a bolometer in conjunction with a lithium fluoride infrared prism spectrometer are shown.
R.W.Fish

536.4 : 539.2
THERMAL EXPANSION AND MELTING OF SIMPLE METALS. See Abstr. 4018

536.413 : 539.2
THERMAL EXPANSION AND HEAT CAPACITY OF SOLID ARGON. See Abstr. 4000

536.413.2 : 548.735.2
4519. X-RAY MEASUREMENTS OF THE THERMAL EXPANSION OF TRIGONAL POTASSIUM, LITHIUM, AND SILVER NITRATES. H.F.Fischmeister.
J. inorg. nuclear Chem., Vol. 3, 182-6 (1956).

Trigonal high-temperature modifications of $LiNO_3$, KNO_3 and $AgNO_3$ were measured. Cell constants at the transition and melting points and expansion coefficients are tabulated for the three salts and for $NaNO_3$. The expansion of these crystals is strongly anisotropic, being greatest along the hexagonal c-axis. For KNO_3, the expansion perpendicular to this axis was found to be slightly negative.

536.413.2 : 537.311.32
DILATATION OF ALCOMAX III. See Abstr. 3438

536.423 : 539.17
4520. THE CHANGE OF THE STATE OF THE COOLANT GAS [AT THE OUTLET] IN CERTAIN GAS COOLED REACTORS.
O.Hellman.
Ann. Acad. Sci. Fennicae A VI, No. 13, 8 pp. (1958).

536.423
4521. NONSTATIONARY PHASE CHANGES INVOLVING A CONDENSED PHASE AND A SATURATED VAPOR. E.L.Knuth.
Phys. of Fluids, Vol. 2, No. 1, 84-6 (Jan.- Feb., 1959).

Nonstationary temperature distributions and evaporation (or condensation) rates are calculated for the case in which the condensed phase is initially at uniform temperature, the latent heat is supplied (or absorbed) by the condensed phase, and the vapour is in the saturated state.

536.424.1
4522. THERMAL EFFECTS OF THE MARTENSITIC TRANSFORMATION IN LITHIUM. D.L.Martin.
Phys. Rev. Letters, Vol. 1, No. 12, 447-8 (Dec. 15, 1958).

Specific heat measurements on b.c.c. lithium, using the same technique and apparatus as for sodium (Abstr. 5841/1958), are reported. The h.c.p. phase has a higher Debye temperature than the b.c.c. phase.
S.Weintroub

536.48 : 537.312.62 : 539.12
4523. RECENT ADVANCES IN PHYSICS. D.Park.
Amer. J. Phys., Vol. 27, No. 4, 234-55 (April, 1959).

This is an elementary review covering recent experimental and theoretical developments in three areas: liquid helium, superconductivity, and properties of elementary particles. Under the last heading are discussions of the nucleon form factors and possible excitation states, and of the universal Fermi interaction.

536.48
4524. VOLUME ANOMALY OF LIQUID He^3 ARISING FROM ITS NUCLEAR SPIN SYSTEM. L.Goldstein.
Phys. Rev., Vol. 112, No. 5, 1483-7 (Dec. 1, 1958).

The anomalous volume expansion coefficient of liquid He^3 derived in a previous work (Abstr. 5817/1956) through a discussion of its nuclear spin system is shown to be describable quantitatively within the statistical thermodynamic formalism attached to its nuclear spin degrees of freedom. The theory predicts, through the large partial negative spin expansion coefficient, a volume minimum or a density maximum of saturated liquid He^3 subject to the volume behaviour determined by its non-spin degrees of freedom. The temperature at which the density maximum should occur is higher than about 0.2°K. At this temperature, or very close to it, the negative spin expansion coefficient has a sharp minimum and the total liquid density is expected to have an inflection point in the density-temperature representative plane. Since the whole anomaly depends directly on the liquid compressibility, it should be most pronounced in the saturated liquid and should decrease under the application of external pressure.

536.48
4525. ON THE QUESTION OF THE EQUILIBRIUM STATE IN He II. W.Klose.
Z. Naturforsch., Vol. 12a, No. 4, 347-8 (1957). In German.

536.48 : 532.7
4526. CONTRIBUTION TO THE PHONON THEORY OF FLUIDS.
R.Eisenschitz and A.Crowe.
Nuovo Cimento Suppl., Vol. 9, No. 1, 262-6 (1958).

In transforming the energy of an assemblage of interacting bosons to a phonon representation,the velocity of sound is expressible in terms of an integral involving in the integrand the energy of interaction between a pair of atoms as a function of the distance. In order to put this expression to a test the energy of interaction between two helium atoms is evaluated at distances smaller than those which were considered by previous authors. The calculated velocity of sound is by far too high. The discrepancy is not due to inaccuracy in the deduction of the energy of interaction.
R.Eisenschitz

536.48 : 532.7
4527. THE THEORY OF A FERMI LIQUID. (THE PROPERTIES OF LIQUID ^3He AT LOW TEMPERATURES).
A.A.Abrikosov and I.M.Khalatnikov
Rep. Progr. Phys., Vol. 22, 329-67 (1959).

This review gives the general theory of an isotropic Fermi liquid constructed by L.D.Landau, and continued by the present authors. The results of the theory are compared with the experimental data on the properties of liquid helium 3 at low temperatures. After a short introduction the authors give the basic premises of L.D.Landau's theory, and in particular the energy of excitations and the interaction function f are derived. The following topics are discussed: The derivation from Galileo's principle of a relation which expresses the effective mass of the excitations in terms of the mass of the atoms and the zeroth harmonic of the function f. The derivation of the specific heat of a Fermi liquid, and an expression for the magnetic susceptibility is deduced; the exchange interaction of the excitations plays a considerable role in this expression. The kinetic equation for the excitations and this is used to find expressions for the momentum and energy flux; the results are applied to the calculation of the coefficient of viscosity, and the coefficient of thermal conductivity is found by an analogous method. The problem of the velocity of sound, in particular, the result obtained by L.D.Landau concerning the possibility of the so-called "zero sound" in a Fermi liquid at sufficiently low temperatures. The problem of dispersion and absorption of sound. The average fluctuations of the distribution function; this result is used to calculate the scattering of light. An expression is given for the total intensity of scattered light, and the frequency and angular distribution are also given. The Appendix shows how the basic premises of the theory of a Fermi liquid can be derived from microscopic considerations; the properties of a rarefied Fermi gas; the microscopic basis of the energy spectrum of a Fermi liquid in the general case, and also a relation between the function f and the scattering amplitude of excitations.

536.48
4528. SOUND VELOCITY AND ADIABATIC COMPRESSIBILITY OF LIQUID HELIUM THREE.
H.L.Laquer, S.G.Sydoriak and T.R.Roberts.
Phys. Rev., Vol. 133, No. 2, 417-22 (Jan. 15, 1959).

The velocity of first sound at 5 Mc/s was measured in Liquid He^3 between 0.34 and 3.14°K. The results are fitted within 0.2% by the equation $u = 183.9 - 5.98T^2 - 0.130T^3 - 0.00176T^8$ (m/sec). Initial pressure coefficients of the sound velocities and a number of derived thermodynamic quantities are also reported.

536.5.081 : 535.23
RADIATION CONSTANTS, THE RADIATION EQUIVALENT OF LIGHT AND THE OPTICAL SCALE OF TEMPERATURE. See Abstr. 3241

536.514
4529. HELIUM TEMPERATURES FROM VAPOR PRESSURE MEASUREMENTS. F.E.Hoare and J.E.Zimmerman.
Rev. sci. Instrum., Vol. 30, No. 3, 184-6 (March, 1959).

It is found that the temperature at any point below the surface of a helium bath, as deduced from pressure measurements over the surface corrected for hydrostatic head, does not agree with the temperature obtained using a vapour pressure bulb, the helium bath pressure invariably indicating a lower temperature, except below the λ point. The discrepancy can be reduced but not eliminated by employing a heater at the bottom of the bath to provide a copious supply of vapour bubbles throughout the bath. A sharp temperature gradient at the surface of the bath is indicated. Below the λ point no discrepancy is observed.

536.532

4530. ON THE USE OF IRON–CONSTANTAN THERMOCOUPLES FOR MEASUREMENT OF LOW TEMPERATURES. W.Koeppe.

Exper. Tech. der Phys., Vol. 4, No. 3, 134-6 (1958). In German.

A short note on the relative merits of copper–constantan and iron–constantan thermocouples, at temperatures as low as 20°K. At −180°C the sensitivity of the former has been reported as 0.019 mV/deg C whilst that of the latter is 0.027 mV/deg C. The characteristics of the iron–constantan couple are given in tabular and graphical form. E.H.Dock

536.58 : 535.376

AMBIENT THERMAL ENERGY ABSORBED BY ELECTROLUMINESCENT P–N JUNCTION. APPLICATIONS TO COOLING. See Abstr. 4477

536.581.3 : 548.733

A LIQUID-HELIUM COLD CELL FOR USE WITH AN X-RAY DIFFRACTOMETER. See Abstr. 4109

536.631

4531. THE SPECIFIC HEATS AND THE HEATS OF TRANSFORMATION OF THE DIFFERENT MODIFICATIONS OF RUBIDIUM NITRATE AND ALSO ITS LATENT HEAT OF FUSION.

A.Mustajoki.

Ann. Acad. Sci. Fennicae A VI, 1958, No. 9, 16 pp. In German.

The specific heat at constant pressure was measured, using a Moser calorimeter, at various temperatures between 50 and 350°C, for both heating and cooling. The results are tabulated and shown graphically. The different transformation points are clearly shown. They are 160°C; 218°C (heating) or 211°C (cooling); 281°C; and the melting point 310°C. The corresponding latent heats and entropies are calculated. S.Weintroub

536.631

4532. SPECIFIC HEAT OF A FACE-CENTERED CUBIC Mn–Fe ALLOY AT LIQUID HELIUM TEMPERATURES.

Chuan-Tseng Wei, Chin-Huan Cheng and P.A.Beck.

Phys. Rev., Vol. 112, No. 3, 696-8 (Nov. 1, 1958).

An Fe + 45 atomic per cent Mn alloy, vacuum melted and homogenized at 1050°C for 48 hours, was found to consist at room temperature of a single face-centred cubic phase, even after an excursion to liquid helium temperatures. Low-temperature specific heats were determined in the range from about 1.7° to 4.8°K. The electronic specific heat coefficient was found to be 14.6×10^{-4} cal mole^{-1} deg^{-2}. The Debye temperature was $\theta = 482^\circ$K.

536.631

4533. LOW-TEMPERATURE HEAT CAPACITY OF PURE AND REDUCED RUTILE. P.H.Keesom and N.Pearlman.

Phys. Rev., Vol. 112, No. 3, 800-4 (Nov. 1, 1958).

Measured between 1° and 20°K. Below 4°K, C for pure rutile is proportional to T^3 with a Debye θ equal to 758°K. Upon reduction a large additional contribution appears which is independent of temperature below 13°K. This is probably due to electrons which do not become degenerate above 1°K because of their very high effective mass (300-500 times the free-electron mass).

536.631

4534. SPECIFIC HEATS OF SOME COPPER-RICH COPPER-NICKEL ALLOYS AT LIQUID HELIUM TEMPERATURES.

G.L.Guthrie, S.A.Friedberg and J.E.Goldman.

Phys. Rev., Vol. 113, No. 1, 45-8 (Jan. 1, 1959).

Helium-temperature heat capacity measurements were made using samples containing 60, 65, 75, and 90 weight per cent of copper in nickel. The results are in approximate agreement with the previous work of Keesom and Kurrelmeyer. The more copper-rich samples have been found to obey a law of the type $c_V = \gamma T + \beta T^3$, but anomalies have been noted in the results of measurements on some of the samples containing 35 and 40 weight per cent of nickel. These anomalies are attributed to a magnetic effect. Analysis of the results shows that the usual collective electron interpretation of the intrinsic magnetization of Cu–Ni alloys is oversimplified.

536.631

4535. LOW-TEMPERATURE SPECIFIC HEATS OF BODY-CENTERED CUBIC Cr–Fe and Cr–Mn ALLOYS.

C.T.Wei, C.H.Cheng and P.A.Beck.

Phys. Rev. Letters, Vol. 2, No. 3, 95-6 (Feb. 1, 1959).

Measurements made over the range 1.6° to 4.2°K, with an estimated accuracy of ±2% for most alloys, were analysed by the usual C_V/T against T^2 extrapolation to $T = 0$ to obtain the electroni specific heat coefficient γ of the temperature - linear term, and values of γ as a function of the electron concentration are shown graphically. S.Weintroub

536.631 : 539.

THE VIBRATIONAL SPECTRUM AND SPECIFIC HEAT OF GERMANIUM. See Abstr. 4007

THERMODYNAMICS

536.7

4536. SOME THERMODYNAMIC PROPERTIES OF A MAPPING.

D.E.Christie.

J. Franklin Inst., Vol. 267, No. 2, 119-33 (Feb., 1959).

It is usual to represent equilibrium states of a simple thermodynamic system by points in the Pv plane and in the Ts plane. In this article attention is focused on the natural correspondence thus established between points of these planes. This correspondence induces topological transformations on point sets, isometric transformations on areas, and projective transformations on slope ratios. Each of these cartographic points of view produces results of thermodynamic significance. In particular the conclusions on slope ratios provide a general view of the concepts of specific heat capacity and bulk modulus. Interesting geometric constructions relating these concepts are developed.

536.7

4537. THERMODYNAMIC PROPERTIES OF THE SYSTEM ARGON–METHANE LIQUID. V.Mathot.

Nuovo Cimento Suppl., Vol. 9, No. 1, 356-7 (1958).

536.7

4538. THERMODYNAMICS OF INHOMOGENEOUS SYSTEMS.

E.W.Hart.

Phys. Rev., Vol. 113, No. 2, 412-16 (Jan. 15, 1959).

A self-consistent thermodynamic formalism is developed for the treatment of the equilibrium of systems, some of whose parameters vary continuously from place to place. The method is specially designed for the description of transition interfaces separating two phases. The energy per unit volume is assumed to depend explicitly on the space derivatives of the molecule densities. Equilibrium conditions are obtained for the appropriate internal variables of the system, and all externally measurable intensive variables are uniquely defined by a variational procedure.

536.75

4539. ON THE IRREVERSIBLE PRODUCTION OF ENTROPY.

F.García Moliner.

An. Real Soc. Espan. Fis. Quim., Vol. 55(A), No. 1-2, 33-6 (Jan.-Feb., 1959). In Spanish

The explicit contribution of an arbitrary type of momentum-dependent force to irreversible entropy production is shown to vanish for forces F such that $\nabla_k \cdot F = 0$, ∇_k being the gradient operator in k-space. The relation to previous treatments of such cases is illustrated. Some thermodynamical implications are discussed.

537.1 : 530.12

ELECTRICITY AND GENERAL RELATIVITY. See Abstr. 4259

ELECTRICITY

ELECTROSTATICS . DIELECTRICS

537.22 : 537.312.5

4540. ON THE CREATION OF ELECTRIC CHARGES BY COOLING A SELENIUM PHOTOCELL. G.Blet.

J. Phys. Radium, Vol. 19, No. 8-9, 681-7 (Aug.-Sept., 1958). In French.

An open-circuit photocell becomes progressively charged when cooled. At 100°K, the potential difference may exceed 2.5 V. This process is discussed in detail, as is also that of discharge, which may be obtained in one of the three following ways: by short-circuiting, by illumination and by heating. In brief, two stable forms of barrier layer are possible: one obtained at $T > 210^\circ$K, the other at temperatures below that threshold. It is thought that the transition from one form to the other might be through migration of electrons from one level to the other.

537.221 : 551.594.12

ELECTRICALLY CHARGED DROPS FROM BUBBLES IN SEA WATER AND THEIR METEOROLOGICAL SIGNIFICANCE. See Abstr. 4149

537.226.08

4541. A SIMPLE DIRECT-READING DIELECTRIC METER. K.V.Srinivasan.

J. sci. industr. Res., Vol. 17B, No. 8, 329-30 (Aug., 1958).

A resonance method of determining the permittivity of liquids is described. Oscillator and detector circuits have similar coils, but the capacitor in the oscillator is immersed in the liquid to be tested, while that in the detector circuit is a variable capacitor whose scale is directly calibrated in terms of permittivity.

K.W.Plessner

537.226.1

4542. THEORY OF THE DIELECTRIC CONSTANTS OF ALKALI HALIDE CRYSTALS. B.G.Dick, Jr and A.W.Overhauser.

Phys. Rev., Vol. 112, No. 1, 90-103 (Oct. 1, 1958).

The simple classical theories of the dielectric constants and compressibility of ionic crystals lead to two relations among the experimental quantities from which arbitrary parameters have been eliminated, the Szigeti relations. Neither is satisfied by the data, indicating the inadequacy of these simple theories. The short-range repulsive interaction between ions with closed shell electron configurations is investigated, and an approximate interpretation of the Born—Mayer potential in terms of overlap integrals is developed. These results are applied to the interaction of model ions consisting of rigid charged shells bound to cores by harmonic restoring forces. Using this model, polarization mechanisms neglected in the simple dielectric constant theory, the "short range interaction polarization", and the "exchange charge polarization" are described. Both arise from charge redistributions occurring when the ions move with resulting changes in electron overlaps. Applied to a crystal, these ion models permit the derivation of generalizations of the Szigeti, Clausius—Mossotti, and Lorenz—Lorentz relations. The e^*/e of the second Szigeti relation can then be calculated and comparison with the e^*/e values derived from experimental data imply that the above polarization mechanisms must be at least in part responsible for the deviation of this parameter from unity. The failure of the first Szigeti relation is discussed and attributed to the inadequacy of the treatment of compressibility. The additivity feature of the simple theory and its absence in the refined theory are discussed in relation to the so-called vacuum and crystal ion polarizabilities.

537.226.1

4543. ON PROPERTIES OF CRYSTALS WITH HIGH PERMITTIVITY. I.Ts.Lyast.

Zh. tekh. Fiz., Vol. 28, No. 11, 2546-7 (1958). In Russian.

Introduction of certain impurities into non-ferroelectric rutile and perovskite-type crystals increases their permittivity up to values of the order of 1000. The author ascribes this effect to the appearance of relaxing Ti ions which, as in $BaTiO_3$, behave as rigid dipoles. The high values of permittivity which can be reached ($\sim$ 5000) suggest that the majority of Ti ions in such crystals must behave as dipoles.

A.Tybulewicz

537.226.1

4544. ON THE THEORY OF THE COERCIVE FIELD OF SINGLE-DOMAIN CRYSTALS OF $BaTiO_3$. V.Janovec.

Czech. J. Phys., Vol. 8, No. 1, 3-16 (1958).

The coercive field E_c is defined as an electric field on the attainment of which the probability of producing anti-parallel nuclei begins to rise extremely rapidly. A theory of the coercive field is given which explains the dependence of E_c on the thickness of the crystal and leads to values which agree with experiment in order of magnitude.

537.226.2

4545. NON-LINEAR EFFECTS IN ROCHELLE SALT. J.Stankowski.

Bull. Acad. Polon. Sci. Ser. Sci. math. astron. phys., Vol. 6, No. 9, 599-602 (1958).

Oscillograms displaying polarization as a function of field were obtained in the region of the Curie point at 24°C. It was found that the P—E relation was non-linear even beyond the point at which domain orientation was complete below the Curie point, and that a different P—E relation, again non-linear, held above the Curie point.

K.W.Plessner

537.226.2

4546. DIELECTRIC RELAXATION SPECTRA OF LITHIUM BOROSILICATE GLASSES. L.Heroux.

J. appl. Phys., Vol. 29, No. 12, 1639-45 (Dec., 1958).

The dielectric relaxation spectra of a system of lithium borosilicate glasses were investigated over the frequency range 0.01 c/s to 500 kc/s and temperatures between 25°-350°C. The spectra of the samples exhibit well-defined peaks in the dielectric loss factor and dispersion in the dielectric constant. The activation energies associated both with the lithium ion mean relaxation frequency and the lithium ion d.c. conductivity (zero frequency conductivity) are constant with temperature; their difference for each sample appears to be an indication of the distribution of activation energies of the sample. The experimental data show that an analytical function proposed by Wagner adequately describes the distribution of relaxation times associated with the lithium ion relaxation process in the glass network. The distribution originates from a spread in activation energies for low lithium concentrations and a spread in the period of vibration of the lithium ions about their equilibrium position for higher concentrations.

537.226.2 : 541.183

4547. RADIOFREQUENCY ABSORPTION STUDY OF THE ADSORBED WATER ON SILICA GEL.

K.Kamiyoshi and J.Ripoche.

J. Phys. Radium, Vol. 19, No. 12, 943-6 (Dec., 1958). In French.

The dielectric absorption of the adsorbed water on silica-gel is studied as a function of water content from 0% to 40% and of temperature from 4°K to 300°K at frequencies 0.09, 1, 10, 100 kc/s. The plot of the activation energy U from ($f_c = A \exp - U/kT$) against the amount of water shows the two well known absorption regions (II and III): there is a minimum of U_{II} for a small amount of water. A third absorption region (I) seems to exist at 79°K for 1 kc/s with U = 0.23 eV. This band is very flat and weak; when the silica gel is rehumidified this band disappears little by little.

537.226.2 : 538.245

4548. THE COMPLEX DIELECTRIC CONSTANT AND PERMEABILITY OF Ni—Cd FERRITE SYSTEM AT MICROWAVE FREQUENCIES. S.Takemoto.

Mem. Coll. Sci. Univ. Kyoto A, Vol. 28, No. 4, 327-35 (May, 1958).

The dielectric constant and permeability of the polycrystalline sintered ferrite system $Ni_{1-x}Cd_xFe_2O_4$ at 9300 and 24 000 Mc/s were measured at room temperature. The mechanisms of conductivity and of dispersion of permeability at microwave frequencies are discussed, and the relationship between conductivity and dielectric constant are also discussed.

537.226.2

4549. ELECTRICAL PROPERTIES OF CERTAIN SINGLE CRYSTALS AND POLYCRYSTALLINE FERRITES.

V.A.Ioffe, G.I.Khvostenko and Z.N.Zonn.

Zh. tekh. Fiz., Vol. 27, No. 9, 1985-95 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 1840-9 (Sept., 1957).

A study was made of the effects of temperature on the resistivity, dielectric constant, and dielectric loss angle, at sonic frequencies, of the solid solution systems consisting of nickel ferrite and zinc ferrite, magnesium ferrite and manganese ferrite, and two single crystals and a ceramic specimen of a solid solution of cobalt ferrite and zinc ferrite. It was found that all the ferrites studied, both ceramic and monocrystalline, have high dielectric constants, strongly dependent on the temperature, in a definite temperature range. The dependence of the dielectric constant on the frequency and temperature is determined by relaxation processes.

537.226.2

4550. ON PECULIARITIES OF FERROELECTRIC DOMAIN STRUCTURE VISUALIZED BY MEANS OF AN ELECTRON MICROSCOPE. G.V.Spivak, É.Igras and I.S.Zheludev.

Dokl. Akad. Nauk SSSR, Vol. 122, No. 1, 54-7 (1958). In Russian.

Carbon and collodion replicas of ferroelectric crystal surfaces were prepared and transmission electron micrographs (× 1000 to × 25 000) were obtained. $BaTiO_3$ and Rochelle salt monocrystals were examined both in as-prepared and in etched states. The results are given in a plate which shows very clearly ferroelectric domains of both crystals and unexplained sub-domain structure in Rochelle salt.

A.Tybulewicz

537.226.2 : 539.21

4551. RADIATION DAMAGE EFFECTS IN FERROELECTRIC TRIGLYCINE SULFATE. A.G.Chynoweth.

Phys. Rev., Vol. 113, No. 1, 159-66 (Jan. 1, 1959).

Peculiar changes occur in the ferroelectric hysteresis loops of single crystals of triglycine sulphate when the crystals are subjected to ionizing radiations (X-rays and electrons). Fully polarized crystals develop hysteresis loops biased along the field axis while partially polarized crystals develop double-loop patterns, each subsidiary loop being biased to the same extent but in opposite directions. The biased loops retain their rectangularity during the early stages of the bombardment. The bias field builds up steadily during the bombardment while the reversible polarization shows no change at first but eventually, at a fairly well-defined value of the bias field, it begins to decay in a fairly rapid manner. Unusual field- and temperature-dependent changes in the shapes of the "damaged" hysteresis loops are observed. Under certain conditions, a double-loop pattern will "anneal" into a normal single loop simply as a result of applying the a.c. field; but when the field is removed, the crystal relaxes back to its double-loop form. Such cycles can be repeated, apparently indefinitely, provided that the field is not removed for too long a period. If this happens, the double-loop pattern fails to respond to further field treatments though it can be returned to the more unstable state by gentle heat treatment of the crystal. The experiments rule out explanation of the effects based on the setting up of space charge fields or on nonuniform damaging of the crystal. It seems most likely that the effects are caused by the gradual building up of a more or less uniform strain in the crystal. The results are discussed in terms of the conventional double-minimum potential energy curve used for describing ferroelectric mechanisms. On the basis of some pyroelectric studies, however, it appears that a rather more complicated potential energy curve is needed to describe ferroelectricity in triglycine sulphate. It is pointed out that, as the X-ray dosages required to produce large changes in the ferroelectric properties are small compared with those usually used in crystallographic determination, it seems most unlikely that the structure of an undamaged triglycine sulphate crystal has yet been determined, and it is conjectured how true this may be of certain other structure determinations for radiation-sensitive organic crystals.

537.226.2

4552. THE MECHANISM OF DEGRADATION OF TITANATE DIELECTRICS.

A.Koller and Z.Pospíšil.

Czech. J. Phys., Vol. 8, No. 3, 315-21 (1958).

A description is given of the processes taking place in dielectric titanates if they are permanently loaded with a direct voltage. Current theories are refuted, and it is stated that with degraded samples exo-emission of electrons appears; the degradation is explained as the production of colour centres.

537.226.2

4553. FERROELECTRIC SWITCHING TIME OF $BaTiO_3$ CRYSTALS AT HIGH VOLTAGES.

H.L.Stadler.

J. appl. Phys., Vol. 29, No. 10, 1485-7 (Oct., 1958).

The ferroelectric switching time of two $BaTiO_3$ singe crystals was measured at voltages up to 1300 V across the crystals' thicknesses, 0.108 and 0.076 mm. The switching time, t_S, can be represented approximately as $t_S = \frac{1}{2}\,kV^{-3/2}$ from V equals 100 to 1300 V applied. The shortest switching time, 7.0×10^{-9} sec, was less than half the time taken by a dilatational wave front to traverse the crystal's thickness, 14.9×10^{-9} sec. The results imply that ferroelectric switching in this voltage range does not involve the movement of elastic waves from one side of the crystal to the other.

537.226.2

4554. TRANSITION TO THE FERROELECTRIC STATE IN BARIUM TITANATE.

D.Meyerhofer.

Phys. Rev., Vol. 112, No. 2, 413-23 (Oct. 15, 1958).

The phase transition in $BaTiO_3$ at the Curie point was investigated on single crystals with optical and electrical techniques. Besides raising the cubic-tetragonal transition about 15°C in the usual way with an electric field along the cube-edge direction, an orthorhombic phase was induced above the Curie point by a field along a face-diagonal direction. Birefringence, polarization, and dielectric constant were measured above and below the Curie point as functions of field strength and field direction. The data fit a unified description using the free energy equation of Devonshire. An atomic model for the induced orthorhombic phase is proposed with Ti ions displaced in alternate cube-edge directions. The shift of the ferroelectric transition with electric field was observed optically and compared with predictions derived from the free-energy curves. Two types of transition were observed: in the slow transition the new phase nucleates at the edges of the crystal and grows by domain-wall motion; in the fast transition, which occurs only if the electric field is changed faster than about 1 $kV/cm^{-1}\,sec^{-1}$, the entire crystal switches in a uniform, continuous motion in 1 to 2 μsec.

537.226.

4555. VELOCITY OF SIDEWISE 180° DOMAIN-WALL MOTION IN $BaTiO_3$ AS A FUNCTION OF THE APPLIED ELECTRIC FIELD.

R.C.Miller and A.Savage.

Phys. Rev., Vol. 112, No. 3, 755-62 (Nov. 1, 1958).

New techniques are described which permit one to reverse the direction of the spontaneous polarization in liquid-electroded single crystals of $BaTiO_3$ with one growing domain which nucleates at a predetermined location on the crystal and then expands through sidewise 180° domain-wall motion until the spontaneous polarization in the entire electroded area is reversed. Measurements of the rate of growth of the single domain for a range of applied electric fields give rise to the first quantitative data on the field dependence of the sidewise 180° domain-wall velocity in $BaTiO_3$. It is found that this wall velocity is given by $\nu = \nu_\infty e^{-\delta/E}$, where δ is several thousand volts per centimetre and ν_∞ is in general of the order of 10 cm sec The fields employed in these measurements were in the neighbourhood of several hundred volts per centimetre and the wall velocities varied from about 10^{-6} cm sec^{-1} to 10^{-2}cm sec^{-1}. The measured field dependence of the wall velocity is indicative of a nucleation mechanism for the wall motion, and it is shown that the equation of motion usually employed for domain boundaries does not describe the sidewise 180° wall motion in $BaTiO_3$. In addition, the well-known $e^{-\alpha/E}$ polarization reversal characteristics of metal-electroded crystals are shown to be consistent with wall motion of the type found in this research.

537.226.31 : 539.2

4556. DIELECTRIC LOSSES IN FLUORSPARS.

V.A.Ioffe and I.S.Yanchevskaya.

Zh. tekh. Fiz., Vol. 28, No. 10, 2154-64 (1958). In Russian.

The dependence of tan δ and permittivity on temperatures in the range 20° to 500°K and on frequencies from 5×10^2 to 5×10^6 c/s for a series of natural monocrystals of fluorspars is analysed. A resonance absorption and anomalous dispersion of permittivity was found in all specimens at 5×10^5 c/s. It was found that for temperatures 200-500°K dielectric losses are caused by resonance phenomena, produced by thermal excitation. The same low frequency of resonance for all specimens may be accounted for by electron processes. It is postulated that the resonance is produced by transition of an electron from one oxygen atom to another in negatively charged aluminium oxide tetrahedron. M.W.Makowski

537.226.32

4557. THE PHENOMENOLOGICAL THEORY OF ELECTRETS.

A.N.Gubkin.

Zh. tekh. Fiz., Vol. 27, No. 9, 1954-68 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 1813-24 (Sept., 1957).

Adams' and Swann's phenomenological theories were developed for short-circuited electrets. It is shown that only when short-circuiting is allowed for can the phenomenological theory give results describing the experimental data for electrets made from Carnauba wax correctly. The theory developed here is also extended to new electrets made from inorganic insulators with electrical conductivities considerably higher than that of Carnauba wax. The analysis shows that the electret lifetime can be defined as $1/4\pi M$, where M mainly depends on the electret conductivity, the surrounding medium and the short-circuiting conditions, and on $1/\alpha$, where α is a parameter specifying the time rate of fall of the semiconstant polarization. The values of $1/4\pi M$ and $1/\alpha$ are calculated for several electrets, as are the hetero- and homocharge magnitudes. It is shown that in most cases the electret lifetime is determined by $1/4\pi M$.

537.228.4 : 538.56

4558. THE CM-WAVE FIELD MEASUREMENTS WITH THE USE OF KERR EFFECT IN CRYSTALS OF AMMONIUM DIHYDROGEN PHOSPHATE.

Y.Fujisawa.

E.T.J. Japan, Vol. 3, No. 1, 23-6 (March, 1957).

Electric field intensity can be determined by the magnitude of Kerr effect caused by the field in some proper medium. Although this method has been applied for electrostatic field and comparatively low frequency field, it should be also available for microwave field if a proper medium is used. From the viewpoint of ease of handling, response to frequency and large electro-optic constant, a crystal of ADP ($NH_4H_2PO_4$) was used to measure cm-wave field, and the possibility of the method was proved.

537.226.8 : 537.312.5

ELECTROSTATIC CHARGING OF CdS SINGLE CRYSTALS UNDER THE ACTION OF HIGH ELECTRIC FIELDS.

See Abstr. 3498

537.228 : 548.74 : 539.234

EFFECT OF ELECTRIC FIELD UPON THE STRUCTURE OF THIN FILMS OF SOME DIPOLAR LONG-CHAIN MOLECULES. See Abstr. 4063

537.228 : 532.5

MECHANICAL MOMENT OF ROTATION OF MIXTURES OF LIQUIDS IN ROTATING ELECTRIC FIELDS. See Abstr. 4336

537.228.1 : 534.133

EQUATIONS OF MOTION FOR DAMPED LONGITUDINAL, TORSIONAL AND FLEXURAL OSCILLATIONS OF PIEZOELECTRIC BARS. See Abstr. 4366

537.228.1 : 534.133

ELECTRICAL EQUIVALENT CIRCUIT OF DAMPED SHEAR VIBRATIONS OF PIEZOELECTRIC BARS. See Abstr. 4367

ELECTRIC CONDUCTION

SEMICONDUCTORS

537.31 : 530.162

OHM'S LAW AND HALL CURRENT. GENERALIZED TRANSPORT THEORY. See Abstr. 4305

537.311.3 : 536.413

4559. ELECTRICAL PROPERTIES AND THERMAL EXPANSION OF THE LAVES PHASES, $CaMg_2$ AND $MgCu_2$.
J.F.Smith and J.R.Ogren.
J. appl. Phys., Vol. 29, No. 11, 1523-5 (Nov., 1958).

Electrical resistivities, temperature coefficients of resistivity, and Hall coefficients were measured on single crystals of hexagonal $CaMg_2$ and on polycrystals of cubic $MgCu_2$. The magnitudes of the measured values fall in the range normally observed in metals. In contrast, measured values for the coefficients of thermal expansion are slightly higher than those observed in metallic elements. Appreciable scatter in measured resistivities on different specimens was observed and is presumably due to variations in the degree of crystalline perfection. For $CaMg_2$ the measured Hall coefficients and the temperature coefficients of resistivity and of thermal expansion show only a small degree of anisotropy. The sign of the Hall coefficients was found to be positive for $CaMg_2$ and negative for $MgCu_2$; this is consistent with previous measurements of magnetic susceptibility made on $MgCu_2$ and its alloys.

537.311.3 : 538.632

4560. THEORY OF THE HALL EFFECT IN FERROMAGNETIC SUBSTANCES. J.M.Luttinger.
Phys. Rev., Vol. 112, No. 3, 739-51 (Nov. 1, 1958).

The Hall effect in ferromagnetic substances is computed on the basis of a simple model, making use of the transport theory of Kohn and Luttinger (Abstr. 5866/1958). The calculation is rigorous but assumes a slowly varying scattering potential, a simple band, and very few conduction electrons. None of these assumptions are very realistic for a true ferromagnet, but one is interested here in only giving a discussion of the types of contributions which can occur. Terms related to those previously found by Smit and by Karplus and Luttinger, and some new ones, are found. In addition, some comments of Smit on the general problem of the ferromagnetic Hall effect are discussed.

537.311.31

4561. ELECTRICAL RESISTANCE DURING THE ISOTHERMAL AGING OF QUENCHED Al–Zn ALLOYS. V.Hovi and Y.Erling.
Ann. Acad. Sci. Fennicae A VI, No. 20, 11 pp. (1959).

The resistance of some Al–Zn alloys of different compositions was measured as a function of time during isothermal ageing at 23°, 100°, and 200°C. The results are in good agreement with, and supplement, the data of Hirano (Abstr. 4705/1956) and other investigators. They also indicate the existence of two independent ageing mechanisms in these alloys. The values measured for the electrical resistance at 23°C confirm Hirano's conception of the relation between the low temperature ageing and the appearance of the Guinier–Preston zones. It is shown that there is an analogy between the change in hardness and in electrical resistance at different temperatures. The increase of the electrical resistance at 200°C and its relation to the formation of the Guinier–Preston zones remain, however, unsolved in this investigation.

537.311.31 : 539.2

4562. THE EFFECT OF ELONGATION ON THE ELECTRICAL RESISTIVITY OF POLYCRYSTALLINE ZINC. H.R.Peiffer.
Canad. J. Phys., Vol. 36, No. 9, 1245-6 (Sept., 1958).

Specimens of high purity Zn were elongated up to 9% at room temperature and then quenched to liquid N_2 temperature. Resistivity increases were observed, which did not recover at room temperature, but which could be annealed out in the region 90-120°C. The main cause of the effect appears to lie in dislocations, but point defects cannot be ruled out. K.W.Plessner

537.311.31

4563. ELECTRICAL PROPERTIES OF InBi. S.Asanabe.
Mem. Fac. Sci. Kyusyu Univ. B, Vol. 2, No. 2, 82-6 (Nov., 1956).

Single crystals of the material were cut from zone-refined ingots, and Hall constant and resistivity measured over a temperature range from 100 to 350°K on three specimens of different orientation. The material had metallic properties with R_H about 10^{-3} cm^3 coulomb^{-1} and resistivity between 10^{-4} and 10^{-5} ohm^{-1} cm^{-1} C.Hilsum

537.311.31 : 538.66

4564. OSCILLATORY ETTINGSHAUSEN–NERNST EFFECT.
C.J.Bergeron, C.G.Grenier and J.M.Reynolds.
Phys. Rev. Letters, Vol. 2, No. 2, 40-1 (Jan. 15, 1959).

Examination of a zinc single crystal at liquid helium temperatures demonstrated the oscillatory Ettingshausen–Nernst effect. The graph relating the E.-N. potential against reciprocal magnetic field looks very similar in form to that for magnetic susceptibility. C.A.Hogarth

537.311.31

4565. VARIATION OF RESISTIVITY ACCORDING TO THICKNESS FOR THIN LAYERS OF LEAD.
F.Ciorăscu, A.Deveny, M.Nachman and M.Oncescu.
Rev. de Physique (Bucarest), Vol. 2, No. 2, 199-208 (1957).

Lead films were evaporated on to a quartz substrate in a vacuum of better than 5×10^{-8} mm Hg. When the substrate was cooled to 77°K during the evaporation, amorphous films were deposited, and the critical thickness, defined as the thickness when the resistivity approached within an order of the bulk resistivity, was 45 A. When the substrate was not cooled, the film was granular and the corresponding critical thickness was 250 A. In each case the critical thickness was larger if the substrate was coated with a thin granular layer of lead prior to the evaporation. The resistivity is shown as a function of the thickness for thicknesses up to 1000 A, and the results are interpreted in terms of the mobility of the lead atoms on the substrate during the evaporation. C.Hilsum

537.311.31

4566. NEW EXPERIMENTAL RESULTS ON THE CONDUCTIVITY OF VERY THIN NICKEL FILMS. A.Colombani and G.Goureaux.
C.R. Acad. Sci. (Paris), Vol. 248, No. 3, 380-3 (Jan. 19, 1959).
In French.

An extension of earlier work (Abstr. 6046/1958) which dealt with films thicker than 35 A. Here the temperature coefficient of resistance (α) of thinner films is measured from 0° to 400°C. In general, α is negative over the whole temperature range, and $|\alpha|$ increases as the thickness decreases. C.Hilsum

537.311.31

4567. THE THERMIC COEFFICIENT OF RESISTIVITY OF TIN IN THIN LAYERS. M.Oncescu.
Rev. de Physique (Bucarest), Vol. 3, No. 1, 71-6 (1958).

Films up to 1700 A thick were deposited on a quartz substrate in a vacuum better than 10^{-7} mm Hg. The temperature coefficient of resistance was then measured over a temperature range from 77° to 300°K. Layers deposited on a substrate cooled to 77°K subsequently became unstable as the substrate warmed to room temperature unless they were thicker than 500 A. Thicker films had a temperature coefficient approaching that of bulk metal. If the substrate was not cooled during the evaporation the films were more stable but, unless the thickness was greater than 1500 A, the temperature coefficient was negative. The explanation for these effects is that amorphous layers are deposited when the substrate is cooled, and the layers crystallize at higher temperatures. On a room temperature substrate the layer is deposited as crystallites. C.Hilsum

537.311.32

4568. MEASUREMENT OF ELECTRICAL RESISTANCE OF SIZED POWDERS AT DIFFERENT BULK DENSITIES.
I. PETROLEUM COKE AND RETORT CARBON POWDERS.
G.D.Joglekar, D.Sen and T.R.Gopalaswamy.
J. sci. industr. Res., Vol. 18A, No. 1, 21-4 (Jan., 1959).

The factors which affect the measurements are discussed. The resistivity of the powders was found to increase with their fineness. For a given size and bulk density, the resistivity of petroleum coke is much lower than that of retort carbon. The resistivity of the powders is also an index of their "graphitizability".

537.311.33

4569. PROCEEDINGS OF THE 1958 CONFERENCE ON SEMICONDUCTORS.
J. Phys. Chem. Solids, Vol. 8, 552 pp. (Jan., 1959). See also Nature, Vol. 182, 1067 (Oct. 18, 1958) and Physics Today, Vol. 12, No. 2, 22-5 (Feb., 1959).

Proceedings of the 1958 International Conference on Semiconductors held at Rochester, N.Y., from August 18-22. Abstracts of most of the papers will be published later.

537.311.33 : 535.343 : 535.337

4570. ZEEMAN-TYPE MAGNETO-OPTICAL STUDIES OF INTERBAND TRANSITIONS IN SEMICONDUCTORS.
E.Burstein, G.S.Picus, R.F.Wallis and F.Blatt.
Phys. Rev., Vol. 113, No. 1, 15-33 (Jan. 1, 1959).

In the presence of a magnetic field the quasi-continuous levels of simple energy bands are coalesced into one-dimensional sub-bands and the "time reversal" degeneracy of the levels is split. The energy levels are characterized by the quantum numbers: $\hbar k_H$, the crystal momentum along the magnetic field direction; l, the Landau magnetic quantum number; and M, the component of the total angular momentum along the magnetic field which is characteristic of the atomic states in the tight-binding limit. In the case of degenerate valence bands, the effect of a magnetic field is complicated by degeneracy effects and the levels in a magnetic field are characterized by two or more pairs of (l, M) values. The selection rules, polarization effects, and the character of the absorption spectra for interband transitions in the presence of a magnetic field are discussed and illustrated by experimental data for Ge and InSb. A discussion of practical and experimental considerations of Zeeman-type interband magneto-optical effects is also presented.

537.311.33

4571. FLUCTUATION OF THE CARRIER DENSITY IN SEMICONDUCTORS. S.V.Airapetyants.
Zh. tekh. Fiz., Vol. 28, No. 9, 1913-16 (1958). In Russian.

Fluctuation of the carrier density in a semiconductor, arising from thermodynamic non-equilibrium fluctuations in the distribution of donors N_d and acceptors N_a present simultaneously in approximately equal numbers, was analytically studied. A formula for the volume concentration of fluctuations c was obtained: $c \cong a^{-1}\exp(-a^2)$, where

$$a = \frac{1}{7}\left(\frac{21}{\pi}\right)^{\frac{1}{4}} n^{\frac{1}{4}} N^{-\frac{1}{2}} \left(\frac{\epsilon\Delta\mu}{e}\right)^{\frac{3}{4}},$$

$\Delta\mu$ the displacement of the chemical potential level in the fluctuation region, expressed in potential units, $n = |N_a - N_d|$, $N \cong N_a - N_d$, and ϵ the dielectric constant. The linear dimensions of the fluctuations are given by $L \cong 10^3(\Delta\mu\epsilon n^{-1})^{\frac{1}{2}}$. M.H.Sloboda

537.311.33 : 538.632

4572. HALL EFFECT IN HIGH ELECTRIC FIELDS.
J.F.Gibbons.
Proc. Inst. Radio Engrs, Vol. 47, No. 1, 102 (Jan., 1959).

The Hall voltage is proportional to the velocity of the carriers, and therefore to the applied electric field at low fields and independent of it at high fields. The larger Hall voltage obtained by the velocity-limited effect (high electric field) is shown to be almost independent of temperature, independent of the thickness of the bar, and no greater for InSb than for Ge or Si. These advantages over behaviour at low electric fields would be very useful in Hall-effect fluxmeters. R.C.Kell

537.311.33 : 621.382

4573. A NOTE ON THE USE OF FILTERS IN PHOTOCONDUCTIVE DECAY MEASUREMENTS. A.C.Sim.
Proc. Instn Elect. Engrs, Paper 2885E [International Convention on Transistors and Associated Semiconductor Devices], publ. May, 1959, 3 pp. To be republished in Vol. 106B (1959).

A theoretical analysis and discussion is given of the effects of the varying depth of absorption of photons in photo-conductive decay experiments for the measurement of excess carrier lifetime and of surface recombination velocity. It is shown that no gross errors need arise from the procedures commonly practised, but that the thickness of filters necessary for accurate results is greater than that generally employed.

537.311.3

4574. OPTICAL METHOD FOR DETERMINING CARRIER LIFETIMES IN SEMICONDUCTORS. L.Huldt.
Phys. Rev. Letters, Vol. 2, No. 1, 3-5 (Jan. 1, 1959).

Light from a tungsten strip lamp was passed through a mechanical chopper, capable of up to 5000 c/s and then transmitted throug a sample of germanium (50 ohm cm, room temperature resistivity) The mean transmission (T) was measured as a function of the chopp frequency (f) and the carrier lifetime ($\tau = 165 \pm 20$ sec) was deduce by comparison with a theoretical curve of T as a function of log $f\tau$. R.Stratto

537.311.33 : 538.6

4575. SURFACE TRANSPORT THEORY. J.N.Zemel.
Phys. Rev., Vol. 112, No. 3, 762-5 (Nov. 1, 1958).

A theory is presented for the dependence of the galvanomagnetic parameters on the surface potential of a semiconductor. The expression for the conductivity reduces to that given by Schrieffer (Abstr. 2732/1955) when the magnetic field is zero. Formal equations for the magnetoconductivity and Hall coefficient are derived. By using a constant relaxation time, and a linear space charge region potential, one can obtain closed-form expressions for the conductivity effective mobility and the Hall effective mobility. The Hall mobility is found to be 13% smaller than the conductivity mobility for large values of the surface potential.

537.311.3

4576. OPTICAL SENSITIZATION OF SEMICONDUCTORS BY CHLOROPHYLL AND RELATED PIGMENTS.
A.Terenin and E.Putzeiko.
J. Chim. phys., Vol. 55, No. 9, 681-7 (Sept., 1958). In French.

Compact layers of chlorophyll, chlorophyllides, pheophytin and phthalocyanins exhibit an internal photoelectric effect due to the migration of positive holes. In addition to these pigments, bacteriochlorophyll, hematoporphyrin and hematin, adsorbed in a monomolecular dispersed form, sensitize n-type semiconductors such as ZnO. HgO and SnO to wavelengths absorbed by the pigment molecules. Th effect is ascribed to an energy transfer to electrons trapped at the surface of the semiconductor. J.Franks

537.311.33 : 537.533.2

INFLUENCE OF DEFECT LEVELS ON PHOTOEMISSION. See Abstr. 3553

537.311.33 : 538.113

THEORY OF IMPURITY PARAMAGNETISM IN SEMICONDUCTORS AT LOW TEMPERATURES. See Abstr. 3625

537.311.33 : 548.52

CONDUCTIVITY FLUCTUATIONS DURING GROWTH OF A SEMICONDUCTING CRYSTAL. See Abstr. 4099

537.311.33 : 548.52

TECHNIQUE FOR GROWING UNIFORMLY DOPED CRYSTALS. See Abstr. 4100

537.311.33

4577. A CONTRIBUTION TO THE SEMICONDUCTING PROPERTIES OF CHALCOGENIDES OF ALUMINIUM, GALLIUM, AND INDIUM. E.Kauer and A.Rabenau.
Z. Naturforsch., Vol. 13a, No. 7, 531-6 (July, 1958). In German.

Describes experimental work on materials of the form $A_2^{III}B_3^{VI}$ which have semiconducting properties. Optical absorption data and the temperature dependences give a picture of the band structures, which are compared with previous measurements by other authors. The increase in energy gap with decreasing atomic number and increasing ionic binding agrees with the laws governing binding energies which, in the materials investigated, appear to be independent of lattice structure. C.A.Hogarth

537.311.33 : 539.2

COMPRESSIBILITY AND PRESSURE DISPLACEMENT OF THE ABSORPTION CONSTANT OF CADMIUM SULPHIDE. See Abstr. 4002

537.311.33

4578. ENHANCED Cu CONCENTRATION IN Ge CONTAINING Ni AT 500°C.

A.G.Tweet and W.W.Tyler.

J. appl. Phys., Vol. 29, No. 11, 1578-80 (Nov., 1958).

Penning has shown (Abstr. 7409/1956) that at 500°C, Cu penetrates into Ni-doped Ge (containing ~ 10^{16} Ni atoms cm^{-3}) to a concentration more than 10 times its thermal equilibrium value. This observation was confirmed and the experiments were extended with the following results: at 500°C the rate of Cu^{64} penetration (in Ni saturated samples) indicates an effective diffusion coefficient D_{eff} of ~ 2×10^{-8} cm^2/sec and a saturation density, n_0, of ~ $10^{16}/cm^3$. No detectable Cu penetration occurs after 10 hr at 400°C. The Cu penetration at 500°C is independent of dislocation density in the sample and also independent of whether or not the Ni has been previously precipitated. The extra Cu is not electrically active. The rate of mixing of ordinary Cu and Cu^{64} by diffusion in Ge samples at 500°C was studied and it was found that D_{eff} for this process is again ~ 10^{-8} cm^2/sec. From these experiments it is concluded that Cu penetration in Ge is not responsible for the 0.04 eV energy level which appears during the early stages of Ni precipitation at 400°C, as Penning suggests. The enhanced penetration of Cu^{64} observed at 500°C may be interpreted as resulting from exchange between interstitially diffusing Cu^{64} and precipitates of either Ni or Cu.

537.311.33 : 539.21

4579. RADIATION-INDUCED RECOMBINATION CENTERS IN GERMANIUM.

O.L.Curtis, Jr, J.W.Cleland and J.H.Crawford, Jr.

J. appl. Phys., Vol. 29, No. 12, 1722-9 (Dec., 1958).

An attempt was made to provide a better understanding of minority carrier recombination processes in irradiated germanium. To this end, studies were made of the minority carrier lifetime of both n- and p-type material, following fast neutron and Co^{60} γ irradiations. The effect of carrier concentration and temperature was determined. The primary conclusion drawn from these investigations is that the recombination process is associated with an energy level located 0.20 eV below the bottom of the conduction band. From measurements of the lifetime in n-type specimens, the hole capture cross-section was calculated and found to be $\sigma_p = 3 \times 10^{-15}$ cm^2 and $\sigma_p = 4 \times 10^{-16}$ cm^2 for neutron and γ-induced centres, respectively. If a second, lower lying level is associated with the second ionization of the defect responsible for recombination, then the effective number of recombination centres is reduced in p-type material as the Fermi level approaches the valence band, due to this ionization. Such a process is in qualitative agreement with the observed data.

537.311.33

4580. RADIATIVE RECOMBINATION IN GERMANIUM.

P.H.Brill and R.F.Schwarz.

Phys. Rev., Vol. 112, No. 2, 330-3 (Oct. 15, 1958).

The dependence of recombination radiation, U, on the excess carrier density δp, and on the equilibrium carrier density, $(n_0 + p_0)$, was studied in 0.2 to 12 ohm cm n- and p-type germanium by simultaneous measurements of output radiation and of photoconductivity as functions of incident light intensity. The results confirm the van Roosbroeck—Shockley theory of band-to-band recombination which predicts that $U = \mathfrak{R}[(n_0+p_0)\delta p^2+\delta p^2]/n_i^2$, where n_i is the carrier density in intrinsic material. As predicted by the theory, a log-log plot of U versus δp gave a straight line with slope of 1.0 for small δp and showed a curvature asympototically approaching a slope of 2 for δp greater than (n_0+p_0). The value of $\mathfrak{R}$ was estimated from the output radiation to be $2.5 \times 10^{13} cm^{-3} sec^{-1}$ which compares favourably with the previously published theoretical value of $1.57 \times 10^{13} cm^{-3} sec^{-1}$. The dependence of δp on incident light intensity shows the behaviour of the effective sample lifetime, which, in most cases, increases slowly with injection level.

537.311.33

4581. SURFACE EFFECTS IN ELECTRON-IRRADIATED Ge AT 80°K.

W.E.Spear.

Phys. Rev., Vol. 112, No. 2, 362-9 (Oct. 15, 1958).

Photoconductivity, surface conductance, Hall and field effect measurements were made before and after electron irradiations. Before irradiation, both n- and p-type specimens show a photoconductive shoulder in the range of photon energies between 0.70 and 0.55 eV, which is connected with a surface effect. Irradiation with energies below the threshold for the introduction of volume defects (about 400 keV) quenches the photoconductivity in the shoulder and causes an increase in surface conductance in n-type, and a decrease in p-type specimens. 4.5 MeV irradiations (a) extend the shoulder to about 0.49 eV and (b) introduce a sharp peak at 0.39 eV. Both features are due to electronic transitions in the surface region. Field effect measurements with steady fields and a superimposed alternating potential indicate that the shoulder is connected with transitions from the valence band into a group of slow surface states lying between 0.70 and 0.58 eV above the valence band. Irradiation below 400 keV increases the surface potential Y until, in n-type specimens, the Fermi level passes through a high concentration of fast states within 0.05 eV of the conduction band. 4.5 MeV irradiations decrease Y; transitions to a second group of slow states lying between 0.4 and 0.2 eV above the valence band can now take place.

537.311.33

4582. FREE-CARRIER ABSORPTION IN N-TYPE Ge.

R.Rosenberg and M.Lax.

Phys. Rev., Vol. 112, No. 3, 843-52 (Nov. 1, 1958).

The structure of the conduction band of Ge is completely taken into account in calculating the cross-section in second-order Born approximation. The second-order matrix element contains first-order matrix elements of electron—photon interaction (derived for anisotropic mass) and of electron-scatterer interaction. Scatterers considered are ionized impurities and phonons belonging to all six branches of the vibrational spectrum. Deformation parameters of electron—phonon interaction are chosen to agree with other experiments. An excellent fit to high-temperature data (450°K), where impurity effects are very small, is obtained without adjusting any parameters. Contributions to the cross-section from processes involving scattering by longitudinal and transverse long-wavelength acoutisc phonons are comparable; their combined effect is matched by energetic-phonon effects when $T > \sim 300°K$. In this temperature range, when $40\mu > \sim \lambda > \sim 10\mu$, contributions from all phonon processes are virtually indistinguishable in their temperature and wavelength (λ^2) dependence. Predicted cross-sections are too low by 20-30% at 293°K, and by a factor of 2-4 at 78°K. The low-temperature results are in apparent disagreement with theoretical results of Fan, Spitzer and Collins (Abstr. 2101/1956). It is suggested that their theory leads to an overestimate in the impurity calculation, and that impurity effects have not yet been explained.

537.311.33 : 536.631

4583. SPECIFIC HEAT OF GERMANIUM AND SILICON AT LOW TEMPERATURES.

P.H.Keesom and G.Seidel.

Phys. Rev., Vol. 113, No. 1, 33-9 (Jan. 1, 1959).

The specific heats of several samples of silicon have been measured between 1.2 and 4.2°K. The Debye characteristic temperature θ_0 at 0°K is estimated to be 636°K, a value slightly lower than previously reported. Measurements on germanium between 0.5 and 4.2°K yield $\theta_0 = 363°K$, in very good agreement with older results. From knowledge of the electronic specific heat and the carrier concentration of several degenerate samples of germanium and silicon, information is deduced concerning the energy band structure of the crystals. Measurements of n-type germanium indicate that the conduction band of this substance has four minima. Similar measurements of silicon indicate that there are six minima in its conduction band. The density-of-states effective masses of both electrons and holes in germanium, calculated from this work on degenerate samples, are not appreciably different than found from cyclotron resonance experiments on pure crystals. This result is consistent with the assumption, used in the calculations, that the addition of impurities to a crystal does not change the density of states in the vicinity of the band edge. For silicon, however, the specific heat yields somewhat larger effective masses for the electrons and holes than obtained from cyclotron resonance. Thus, the addition of impurities to silicon affects the shape of the bands.

537.311.33

4584. CONDUCTIVITY OF GRAIN BOUNDARIES IN GROWN GERMANIUM BICRYSTALS.

B.Reed, O.A.Weinreich and H.F.Mataré.

Phys. Rev., Vol. 113, No. 2, 454-6 (Jan. 15, 1959).

The conduction of current in the grain boundary of a grown germanium bicrystal was studied as a function of doping. For all samples, the behaviour shows only a small temperature dependence from 2-300°K. The conduction in the grain boundary is ohmic if no secondary effects are introduced by conduction in the bulk material. Samples with no doping are all characterized by having a resistivity of about 3000 to 11 000 ohms per square. The lack of a strong dependence on doping indicates that the grain boundary behaviour is not due to the segregation of impurities at the boundary.

537.311.33 : 536.48

4585. ON THE IMPACT IONIZATION IN SINGLE CRYSTAL GERMANIUM AT TEMPERATURES IN THE REGION FROM 4.2 TO 10°K. G.Finke and G.Lautz.
Z. Naturforsch, Vol. 12a, No. 3, 223-5 (1957). In German.

Measurements of the Hall effect established that the decrease in resistivity with rising applied electrical field and the reversible breakdown at a few V/cm were due to the increase of carrier density by impact ionization of neutral impurities. Extremely high values of the transverse magnetoresistance ratio in the impact ionization region were observed (e.g. a factor 20 for 250 gauss at 4.2°K). R.Stratton

537.311.33

4586. ELECTRICAL CONDUCTIVITY OF EVAPORATED LAYERS OF AMORPHOUS GERMANIUM. L.Reimer.
Z. Naturforsch., Vol. 13a, No. 7, 536-41 (July, 1958). In German.

Measurements were carried out in the temperature range 20°C to 400°C and the results are discussed in relation with the properties of the crystalline form of germanium. R.Stratton

537.311.33 : 539.21

4587. ON THE RECOMBINATION OF MINORITY CARRIERS IN N-TYPE GERMANIUM THROUGH LATTICE DEFECTS INDUCED BY FAST NEUTRON IRRADIATION. A.V.Spitsyn and V.S.Vavilov.
Zh. eksper. teor. Fiz., Vol. 34, No. 2, 530-1 (1958). In Russian. English summary: PB 141052T-1, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Capturing cross-sections lying between 0.8×10^{-16} and 8×10^{-16} cm^2 are reported. The mean number of displaced Ge atoms per scattered neutron was found to be between 260 and 350. P.T.Landsberg

537.311.33 : 539.21

EFFECT OF MONOENERGETIC FAST NEUTRONS ON N-TYPE GERMANIUM. See Abstr. 4045

537.311.33

4588. THE VOLUME-GRADIENT E.M.F. DURING CURRENT FLOW THROUGH GERMANIUM. P.I.Baranskiĭ and É.I.Komukhaev.
Zh. tekh. Fiz., Vol. 28, No. 9, 1896-904 (1958). In Russian.

If two probes were placed a small distance apart along the side of a rectangular Ge specimen through which a direct current, i, was flowing, the potential differences, V_+ and V_-, for positive and negative current flow were found to be unequal in magnitude. By exploring specimens with widely differing shapes of resistivity variation, it was found that for all of them $E (\equiv |V_+| - |V_-|) \propto \text{grad}\,\rho$; polycrystalline and single crystal n and p-type specimens were studied; the constant of proportionality was of opposite sign for n and p-type Ge. Several experiments showed that the effect was a true volume one. It was found that E could not be written as $\propto i^n$, for any n. The effect appeared to the thermal — a decaying e.m.f. was observed from the probes when the current was switched off. If alternating current was used, however, there was no decaying e.m.f.; inhomogeneous Joule heating is thus not involved. No consistent explanation of the effect is advanced. K.F.Hulme

537.311.33 : 537.533.2

THE PHOTOELECTRIC AND SECONDARY ELECTRON EMISSION OF GERMANIUM. See Abstr. 3561

537.311.33 : 535.345

INFRARED ABSORPTION BY CONDUCTION ELECTRONS IN GERMANIUM. See Abstr. 4458

537.311.33 : 537.533.2

PHOTOELECTRON EMISSION FROM MERCURY SELENIDE. See Abstr. 3560

537.311.33

4589. EVAPORATED LAYERS OF SEMICONDUCTING III-V COMPOUNDS InAs AND InSb. K.G.Günther.
Z. Naturforsch., Vol. 13a, No. 12, 1081-9 (Dec., 1958). In German.

Layers, from 0.5 to 35 μ thick, were made by the "3-temperature process". This involves the separate evaporation of the elements at temperatures T_1 and T_2 and deposition at a third temperature, T_3. T_1 and T_2 are chosen so that there is an excess of the more volatile element in the vapour phase. T_3 can then be chosen so that only molecules of the desired compound are deposited while excess atoms of the volatile element are re-emitted into the vapour phase. For InAs, Hall mobilities up to 13.000 cm^2/(V sec) and Hall constants up to 100 cm^3/(A sec) were observed giving Hall voltages of several volts. Both the Hall constant and mobility increase with the grain size of the polycrystalline layers. R.Stratton

537.311.

4590. ELECTRICAL CONDUCTIVITY OF NiO NEAR THE CURI TEMPERATURE. E.Yamaka and K.Sawamoto.
Phys. Rev., Vol. 112, No. 6, 1861-2 (Dec. 15, 1958).

The resistivity of single-crystal and polycrystalline NiO were observed experimentally in the temperature range from room tem perature to 400° C through the Curie temperature (T_C) in order to study the influence on electrical conduction of the superexchange coupling characteristic of antiferromagnetism. The relation of re sistivity versus 1/T for single crystals is observed to behave rath linearly in the regions both above and below a small discernible bending (kink) near T_C, from which the corresponding activation energies may be determined. The result seems to support the Heitler—London approach by Heikes in the NiO crystal. The speci mens, in which partial spin alignment was introduced by stress-annealing through T_C along a direction of [111], show an anomalous increase of resistivity along the stress axis near T_C in the heating process, whereas in the following cooling process the anomaly in resistivity is not observed. The result seems to show that the spin alignment has been disturbed appreciably during the heating process and that then the electrical conduction may be affected by the super exchange coupling, as suggested in the Heitler—London model of NiO.

537.311.3

4591. THE MOBILITY OF ELECTRONS AND HOLES IN SOLID SOLUTIONS BASED ON LEAD AND BISMUTH TELLURIDES. S.V.Aĭrapetyants, B.A.Efimova, T.S.Stavitskaya, L.S.Stil'bans and L.M.Sysoeva.
Zh. tekh. Fiz., Vol. 27, No. 9, 2167-9 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 2009-11 (Sept., 1957).

This paper shows that for bismuth and lead tellurides electrons in the conductivity zone, move within the cation sublattice and holes and, in the partially filled zone, move within the anion sublattice.

537.311.33 : 548.52

4592. ON THE RELATION BETWEEN CRYSTALLIZATION AND ELECTRICAL RESISTANCE OF SELENIUM FILMS. I. PURE SELENIUM. K.Hashimoto, S.Yokoya, K.Hirakawa and A.Okazaki.
Mem. Fac. Sci. Kyusyu Univ. B., Vol. 1, No. 5, 151-6 (Sept., 1955).

Amorphous selenium films 40 and 80 μ thick were produced on KCl substrates by evaporation, and they were then crystallized by heating at constant temperature. As the film crystallizes its resistance falls according to a law $R = R_0 \exp\{A/(t + \tau)\}$, where R_0 is the final resistance, t the time, τ a constant dependent on the previous thermal history, and A a constant dependent on the temperature of the heat treatment. The constant A has two minima, at 80° and 120°C, and is larger for the thicker films. The minima occur because the number of nucleation sites is greatest at about 90°C and the velocity of growth is largest at about 150°C. C.Hilsum

537.311.33

4593. DEEP ENERGY LEVELS IN SILICON. H.Irmler.
Z. Naturforsch, Vol. 13a, No. 7, 557-9 (July, 1958). In German.

Summarizes, prior to publication of full treatment, calculations of the energy levels of recombination centres, produced by various treatments, from measurements of the variation of resistivity and lifetime with temperature. G.C.Williams

537.311.33

4594. THE INFLUENCE OF SURFACE STATE ON THE MEASUREMENT OF DIFFUSION LENGTH IN SILICON. P.Gosar and H.Ménaché.
J. Phys. Radium, Vol. 19, No. 12, 930-8 (Dec., 1958). In French.

The influence of different surface effects on the measurement by by the travelling light spot method (Valdes method) on silicon is discussed. The theoretical and experimental investigation shows the importance of currents in the inversion layer of the surface for the interpretation of experimental results.

537.311.33

4595. RADIATIVE RECOMBINATION AND ELECTRON MULTIPLICATION IN SILICON. S.Müller.
Z. Naturforsch., Vol. 13a, No. 3, 240-1 (March, 1958). In German.

Studied in reverse-biased silicon p—n junctions. The experimental results are in agreement with the observations of Chynoweth and McKay (Abstr. 4404/1956). G.C.Williams

537.311.33

4596. A BULK EFFECT DURING THE ETCHING OF SILICON SINGLE CRYSTALS. H.Benda.

Z. Naturforsch., Vol. 13a, No. 4, 354-5 (April, 1958). In German.

The measured effective minority carrier (electrons) recombination time in thin plates (0.5 to 2 mm) was observed to decrease after etching. Analysis of the results suggests that the bulk recombination time is reduced, which may be due to the diffusion of hydrogen into the body of the plates during etching. R.Stratton

537.311.33 : 539.2

MECHANISM OF THE FORMATION OF DONOR STATES IN HEAT-TREATED SILICON. See Abstr. 4033

537.311.33 : 539.2

RECOMBINATION PROPERTIES OF GOLD IN SILICON. See Abstr. 4035

537.311.33 : 669

PRODUCTION OF CONTROLLED SINGLE AND MULTIPLE DIFFUSION LAYERS IN SILICON SEMICONDUCTORS. See Abstr. 4191

537.311.33

4597. DEPENDENCY OF THE ELECTRICAL RESISTANCE OF THIN ZINC OXIDE LAYERS ON MECHANICAL STRAINS. M.Teichgräber and H.Straubel.

Z.Naturforsch, Vol. 12a, No. 6, 524 (1957). In German.

The ratio of the fractional increase of resistance to that of length was found to be of order −30 to −60 for layers about 1.4 μ down to 0.2 μ thick, respectively. R.Stratton

537.311.33

4598. GERMANIUM DIFFUSED MINICRYSTALS AND THEIR USE IN TRANSISTORS. I.A.Lesk and R.E.Coffman.

J. appl. Phys., Vol. 29, No. 10, 1493-5 (Oct., 1958).

The diffused minicrystal process yields a germanium drift p—n—p bar-type transistor structure that has fewer practical limitations on emitter, base, and collector resistivities and on base width, than other processes used to make transistor bars for use in high-frequency transistors. Unneutralized power gains greater than 40 dB at $\frac{1}{2}$ Mc/s have been commonly attainable with transistors made using bars having 0.1-mil base widths. Although the p—n—p bars are inherently usable to very high frequencies, base lead overlap capacities have thus far limited the application of early developmental units in this region.

537.311.33

4599. A METHOD OF STUDYING SURFACE BARRIER HEIGHT CHANGES ON TRANSISTORS.
J.R.A.Beale, D.E.Thomas and T.B.Watkins.

Proc. Phys. Soc., Vol. 72, Pt 5, 910-14 (Nov., 1958).

The surface barrier height is changed by a Bardeen—Brattain ambient cycle and by the application of a transverse field to the surface. Since the surface recombination velocity s depend on this height, the surface effects in an alloy junction transistor may be studied by observing the collector to base current gain, which is inversely proportional to s. Preliminary results are given. C.Hilsum

537.311.5 : 538.3

4600. ON THE STATIONARY ELECTRIC CURRENT DISTRIBUTION IN THE SOLID HELICOID WITH INFINITE LENGTH. T.Iijima.

Bull. Electrotech. Lab. (Tokyo), Vol. 21, No. 10, 755-65 (Oct., 1957).

537.311.62 : 539.2

THEORY OF CYCLOTRON RESONANCE IN METALS. See Abstr. 4015

537.312.5

4601. VARIATION WITH TIME OF THE ABSOLUTE AND SPECTRAL SENSITIVITIES OF PHOTOCELLS AND PHOTO-ELEMENTS. L.Foitzik and H.Zschaeck.

Exper. Tech. der Phys., Vol. 4, No. 3, 111-23 (1956). In German.

Reports measurements over a period of 500 days of the sensitivity of 24 commercial photocells. There is a considerable variation both of absolute sensitivity and of spectral sensitivity, although the variation is less for the barrier layer cells. The regions of the spectrum in which the cells have low absolute sensitivity tend to have the greatest variation with time. R.W.Fish

537.312.5

4602. ROLE OF TRAPS IN THE PHOTOELECTROMAGNETIC AND PHOTOCONDUCTIVE EFFECTS. R.N.Zitter.

Phys. Rev., Vol. 112, No. 3, 852-5 (Nov. 1, 1958).

When carriers recombine through traps, the excess concentrations of mobile electrons and holes are not necessarily characterized by a single lifetime τ. Under the assumption that electrons and holes have separate lifetimes which, in general, are different, expressions for the steady-state photoelectromagnetic and photoconductive currents are obtained which show that in certain cases the photoelectromagnetic current is determined by a lifetime different from the one determining the photoconductive current. The results of the photoelectromagnetic and photoconductive measurements can be used to evaluate the parameters of any particular model which might be postulated for the recombination process. However, the theoretical treatment of the photoelectromagnetic and photoconductive effects presented here is independent of such models and so can be used as a method for testing their validity.

537.312.5 : 535.371

4603. ON THE PHOTOELECTRIC PROPERTIES OF PHOSPHORS. H.Meier.

Z. wiss. Photogr., Vol. 51, No. 7-12, 208-44 (1956). In German.

A survey is given of literature on photoconduction in phosphors, particularly in sulphides and a discussion of the energy band model for photoconduction phenomena. G.F.J.Garlick

537.312.5 : 535.37

LOW-TEMPERATURE LUMINESCENCE AND PHOTOCONDUCTIVITY OF AgCl. See Abstr. 4463

537.312.5

4604. THE EFFECT OF SURFACE RECOMBINATION ON THE KINETICS OF PHOTOCONDUCTION IN SEMICONDUCTORS.
É.I.Rashba and M.K.Sheĭnkman.

Zh. tekh. Fiz., Vol. 28, No. 9, 1883-9 (1958). In Russian.

The effect of surface recombination on the shape of curves showing the growth and decay of photoconductivity was studied at various values of the light absorption coefficients. It was shown that surface recombination plays a substantial part already in the early stages of the relaxation processes in the photocurrent. The spectral dependence of the steady photocurrent, quantum efficiency, and life-time were also investigated. M.H.Sloboda

537.312.5 : 548.55

PHOTOCONDUCTIVITY OF THIN ANTHRACENE SINGLE CRYSTALS See Abstr. 4105

537.312.5

4605. ENHANCEMENT OF THE PHOTOCONDUCTIVITY OF SINGLE CRYSTALS OF CADMIUM SULPHIDE BY IRRADIATION IN AN ATOMIC PILE. M.Martineau.

C.R. Acad. Sci. (Paris), Vol. 247, No. 6, 639-43 (Aug. 11, 1958). In French.

Single crystals of pure CdS and brown crystals containing excess Cd were irradiated with an integrated neutron flux of about 10^{18} cm^{-2}. Photoconductivity studies, using white light and X-rays, showed that the neutron bombardment had caused a permanent increase in the photoconductivity current by a factor of 800 for the pure crystals and a factor of 20 for the impure crystals. The relative increase in the photoconductivity current was greatest for samples which were initially least photosensitive. This enhancement of photoconductivity, due to lattice defects created by the bombardment, is comparable with that produced by the addition of metallic impurities. C.H.B.Mee

537.312.5

4606. INVESTIGATIONS ON THE DIFFUSION OF CHARGE CARRIERS IN CdS. J.Auth and R.Ridder.

Z. Naturforsch., Vol. 13a, No. 5, 426-7 (May, 1958). In German.

The diffusion was determined by measuring the photocurrent between two probes as a function of their distance from the illuminated region. Two characteristic diffusion lengths, L_1 and L_2, were found. L_1 varied between 1 and 15 μ according to the origin of the crystal and was ascribed to ambipolar diffusion; L_2 was 500 μ and temperature-independent, and was connected with the re-absorption of luminescent light. B.T.M.Willis

537.312.5

4607. DISLOCATIONS IN CdS CRYSTALS AND THEIR EFFECT ON PHOTOCONDUCTIVITY. E.Votava.

Z. Naturforsch., Vol. 13a, No. 7, 542-4 (July, 1958). In German.

CdS crystals with well developed growth spirals were grown on heated sintered CdS discs. Dislocation configurations were revealed by etching in HCl. Measurements of conductivity, on scanning a small angle grain boundary with a light probe, confirmed that the presenced of dislocations can reduce the electron lifetime. J.Franks

537.312.5

4608. ON THE ELECTRICAL BEHAVIOUR OF CdS SINGLE CRYSTALS WITH VOLTAGE PULSES IN THE BREAKDOWN REGION. K.W.Böer, J.Dziesiaty and U.Kümmel.
Z. Naturforsch., Vol. 13a, No. 7, 560-2 (July, 1958). In German.

Experiments with rectangular pulses of fixed height showed that the current decreased when either the pulse width (from 3 to 1000 μsec) or the repetition frequency (from 10 to 10^3 c/s) were increased. Measurements, on various samples, with fast (3 μsec) single pulses gave currents proportional to a power of the voltage. The index decreased (ranging from about 5 to 1 for the various samples) as measurements were carried out first in the dark and then with increasing illumination. The results are related to dielectric (polarization) after-effects which occur if the crystals are non-homogeneous. R.Stratton

537.312.5

4609. AN INVESTIGATION OF THE SPECTRAL DISTRIBUTION OF PHOTOCONDUCTIVITY FOR CdS SINGLE CRYSTALS AT 77° AND 20°K. V.L.Broude, V.V.Eremenko and M.K.Sheĭnkman.
Zh. tekh. Fiz., Vol. 28, No. 10, 2142-51 (1958). In Russian.

Photoconductivity (ϕ), photocarrier lifetime (τ), and optical absorption (K) are compared in the range 20 200-22 700 cm^{-1} for various crystals. It was found that the fine structure of ϕ at low temperatures cannot be explained in terms of variation of either τ or K alone; it appears necessary to take into account a combination of these, and perhaps other, factors. It is noted that evaporated indium contacts become non-ohmic at low temperatures, though fused indium contacts do not. C.H.L.Goodman

537.312.5 : 539.2

INTERNAL PHOTOEFFECT AND EXCITON DIFFUSION IN CADMIUM AND ZINC SULFIDES. See Abstr. 4029

537.312.5 : 548.523

PHOTOVOLTAIC CHARACTERISTICS OF CdS CRYSTALS GROWN FROM MELT. See Abstr. 4102

537.312.5

4610. THE QUANTUM EFFICIENCY OF THE [INTERNAL] PHOTO-ELECTRIC EFFECT IN GERMANIUM FOR THE 0.3-2 μ WAVELENGTH REGION. S.Koc.
Czech. J. Phys., Vol. 7, No. 1, 91-6 (1957).

The absolute value of the quantum efficiency was measured by means of the photovoltaic effect on a p–n junction. Two different regions were found. In the region from the infrared absorption edge of germanium to a wavelength of 5750 A a practically constant number of electron–hole pairs, approximately equal to one, is produced per photon absorbed. In the second region, from a wavelength of 5750 A and lower, the number of generated pairs of current carriers is proportional to the total energy absorbed. In this region an energy of 2.5 eV is necessary to form an electron–hole pair.

537.312.5

4611. PHOTOCONDUCTIVE RESPONSE OF SINGLE CRYSTAL GERMANIUM LAYERS PREPARED BY THE PYROLYTIC DECOMPOSITION OF GeI$_2$. D.C.Cronemeyer.
J. appl. Phys., Vol. 29, No. 12, 1730-5 (Dec., 1958).

Layers of single crystal germanium were prepared by pyrolytic decomposition of GeI$_2$ at about 350°C upon single crystal seeds of germanium by Marinace. The substrate germanium could be removed and the resultant thin layers ($\sim 5 \times 10^{-3}$ cm) studied. The Hall coefficient and resistivity measured on these layers by Dunlap et al. showed that the layers as grown were usually n type and contained about 10^{16} donors/cm^3. These donors are situated at 0.22 ± 0.04 eV below the conduction band. In the work reported here, the photoresponse of such layers at 77°K was found to extend to about 6 μ in substantial agreement with this thermal activation energy. The 0.2 eV donors apparently can be annealed out by prolonged heating at 550°C. The layers could also be intentionally doped with standard acceptors such as Al during formation. It was hoped that it would be possible to obtain the incorporation of Au into the layers. For this purpose, layers for which Au doping was attempted were annealed to remove the 0.2 eV donors. Although some of the layers became p type, a comparison of the photoresponse at 77°K with the photoresponse obtained for a 5×10^{-3} cm thick p-type plate of regularly Au-doped germanium showed no evidence for the 0.15 eV Au level. Likewise, annealed layers for which Ag doping was attempted were examined but yielded no positive identification of the 0.14 eV level of Ag.

537.312.

4612. THE EFFECT OF CONTACTS ON THE PHOTOCONDUCTIVITY OF RED MERCURY IODIDE. E.Batt and F.Stöckmann.
Z. Naturforsch., Vol. 13a, No. 4, 352-4 (April, 1958). In German.

Measurements of the variation of photocurrent with voltage in HgI$_2$ crystals indicated that sublinear or superlinear laws were obeyed depending on the nature of the electrode contact. J.Franks

537.312.5 : 535.345

PHOTOCONDUCTIVITY IN MAGNESIUM OXIDE CRYSTALS. See Abstr. 4459

537.312.5

4613. THE NOISE SPECTRUM AND FREQUENCY DEPENDENCE OF PHOTOCURRENT IN THALLIUM SULPHIDE PHOTORESISTORS. L.Ya.Pervova.
Radiotekhnika i Elektronika, Vol. 3, No. 3, 405-8 (1958). In Russian.

Experimental investigation shows that the frequency characteristic of photocurrent as measured with weak light beams is similar to the curve of the spectral noise distribution. The noise spectrum in the band 0.3 to 700 c/s consists of three regions; at low frequencies the noise varies little with frequency, at medium frequencies it varies as f$^{-\alpha}$, where α varies between 0 and 2, and at frequencies near 700 c/s it varies as f^{-2}. It is concluded that the noise consists of two components, a modulation component at low frequencies and a shot noise component at higher frequencies. R.C.Glass

537.312.5

4614. PHOTOCONDUCTION AND SURFACE EFFECTS WITH ZINC OXIDE CRYSTALS. R.J.Collins and D.G.Thomas.
Phys. Rev., Vol. 112, No. 2, 388-95 (Oct. 15, 1958).

Large photoconductive effects have been observed on single crystals of ZnO at 300° and 78°K. At 300°K the decay of the photoconductivity is strongly dependent on the ambient conditions, being slow in vacuum and fast in wet oxygen. This shows that the conductivity is associated with the surface. The effects are essentially independent of the dark conductivity of the crystals and cannot be accounted for by the desorption of adsorbed oxygen. It is proposed that holes from hole electron pairs discharge lattice oxygen ions at the surface, producing a surface excess of zinc and an electron enrichment layer in which conduction occurs. The formation of this layer has been followed as a function of the total number of photons incident on the crystal. In the initial stages quantum efficiencies as high as 0.25 have been observed for this process.

537.312.6

4615. CHARACTERISTICS OF THE TEMPERATURE–RESISTIVITY RELATIONSHIP FOR LIQUID EUTECTIC SYSTEMS. F.Gaĭbullaev and A.R.Regel'.
Zh. tekh. Fiz., Vol. 27, No. 9, 1996-2005 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 1850-7 (Sept., 1957).

The electrical conductivities of eutectics in the systems Au–Sn, Pb–Te, Cu–Te, Ge–Te, Sn–Te, Cu–Sb, Bi–Te, Pb–Sn, Bi–Cd, Cd–Zn, Cd–Sn, Bi–Sn, Bi–Pb, Sn–Zn, Cd–Pb, Pb–Sb, Ag–Sb, Ag–Sn were measured between room temperature and 1200°C. It is shown that the conductivity–temperature relationship for the systems Au–Sn, Pb–Te, Cu–Te, Ge–Te, Sn–Te, Cu–Sb, Bi–Te, Sn–Zn, Cd–Pb, Ag–Sb, Pb–Sb, Ag–Sn has well defined special points. These peculiarities in the conductivity–temperature relationship lead to the conclusion that there is a fairly sharp transition in the melts from a quasieutectic structure to homogeneous atomic solutions in this temperature region. The results confirm the theory of Danilov and Radchenko concerning the preservation of a quasieutectic structure in melts of eutectic composition, and show that a quasieutectic structure may persist in a melt over a temperature range of several hundred degrees.

537.312.62

4616. THE THEORY OF SUPERCONDUCTIVITY. C.G.Kuper.
Advances in Phys., Vol. 8, 1-44 (Jan., 1959).

An up-to-date review of the Bardeen–Cooper–Schrieffer theory and subsequent work, including a discussion of the Meissner effect problem. 110 references. R.G.Chambers

537.312.62

4617. THE MODERN THEORY OF SUPERCONDUCTIVITY. I.M.Khalatnikov and A.A.Abrikosov.
Advances in Phys., Vol. 8, 45-86 (Jan., 1959).

A detailed development of the B.C.S. theory, using the Bogolyubov approach. Discusses particularly the thermodynamic properties, the penetration depth and the high-frequency behaviour.
R.G.Chambers

537.312.62 : 539.12 : 536.48

RECENT ADVANCES IN SUPERCONDUCTIVITY. See Abstr. 4523

537.312.62

4618. FLUCTUATIONS IN THE INTERMEDIATE STATE OF SUPERCONDUCTING TANTALUM.

D.C.Baird.

Canad. J. Phys., Vol. 37, No. 2, 129-35 (Feb., 1959).

Current noise in the intermediate state of superconducting tantalum has been studied by using continuous recording of the potential across a wire carrying a current greater than the critical. The pattern of the noise fluctuations becomes clarified by the use of short specimens showing the noise to arise from spontaneous transitions between discrete resistance levels. The nature of these levels is described and their existence attributed to an intermediate state structure which is not small in scale compared with the specimen dimensions. The dependence of the resistance level scheme on the sample demonstrates the importance of the influence of the lattice structure.

537.312.62 : 539.89

4619. EFFECTS OF PRESSURE ON THE SUPERCONDUCTING TRANSITION TEMPERATURES OF Sn, In, Ta, Tl, AND Hg.

L.D.Jennings and C.A.Swenson.

Phys. Rev., Vol. 112, No. 1, 31-43 (Oct. 1, 1958).

Solid parahydrogen was used as a transmitter of approximately hydrostatic pressure to study the effects of pressures up to 10 000 atm on the superconducting transition temperatures of polycrystalline tin, indium, tantalum, thallium, and mercury. The technique used allowed an approximate evaluation of the effects of sample deformation and pressure gradients, and the results are considerably more accurate than the high-pressure data previously available. The transition temperature data for tin and indium showed considerable curvature when plotted against pressure, but gave a roughly linear relationship when plotted against volume. No curvature was found for tantalum. The thallium data agree qualitatively with previous work, and show a maximum in the transition temperature against pressure curve at about 2000 atm. The mercury results were anomalous in that two distinct transition temperature against pressure curves (with different zero-pressure transition temperatures) were found; one when the pressure was kept below 4000 atm, and the other when the sample was cycled from zero to 10 000 atm. Other experiments have shown that these results are due to two different modifications of solid mercury, each of which can exist at liquid helium temperatures.

537.312.62

4620. CRITICAL FIELD MEASUREMENTS ON SUPERCONDUCTING LEAD ISOTOPES.

D.L.Decker, D.E.Mapother and R.W.Shaw.

Phys. Rev., Vol. 112, No. 6, 1888-98 (Dec. 15, 1958).

The measurement of the isotope effect upon the superconducting critical field of lead was extended from T_c to 1.28°K, and an accurate critical-field curve for lead is reported for this temperature range. The measured critical-field curve is expanded as a function of T^2 and used in calculating the thermodynamic properties of lead. The values for the coefficient of the electronic specific heat in the normal state and for the latent heat of the superconducting transition are in good agreement with calorimetric measurements. The electronic specific heat in the superconducting state does not show an exponential 1/T dependence but instead a close resemblance to a T^4 dependence below 5°K. The temperature dependence of the critical field of lead, like that of most superconductors, is not parabolic. However, the observed H_c values lie above a parabola passing through H_0 and T_c which is in the opposite direction from the deviations shown by all other superconductors for which precise data are available. It is shown that an empirical correlation exists for superconductors between the deviation from parabolic behaviour and T_c/θ_0, where θ_0 is the Debye temperature at T = 0°K. Measurements of the isotope effect upon the critical field below T_c show small differences in the coefficient of the normal electronic specific heat, γ, between specimens but in general give support to the principle of similarity in lead to about the same precision as has been reported for other superconductors.

537.312.62

4621. EFFECT OF THE ENERGY GAP ON THE PENETRATION DEPTH OF SUPERCONDUCTORS.

A.L.Schawlow and G.E.Devlin.

Phys. Rev., Vol. 113, No. 1, 120-6 (Jan. 1, 1959).

The dependence on temperature of the penetration depth of superconducting tin crystals was measured by a new low-frequency (100 kc/s) method. The sample served as the core of a solenoid whose inductance changed with the penetration depth. The inductance controlled the frequency of an oscillator which was measured precisely. It is found that there are departures from the law $\lambda = \lambda_0[1-(T/T_c)^4]^{1/2}$ derived from the Gorter–Casimir two-fluid theory. The departures are shown to arise from an energy gap in the spectrum of electron excitations and are qualitatively like those predicted by Lewis' extension of the two-fluid model to include a gap. Throughout the temperature range from 1.8 to 3.69°K the measured penetration depths agree well with the theory of Bardeen, Cooper, and Schrieffer.

537.312.62

4622. CONDUCTION ELECTRON-MAGNETIC ION INTERACTION IN RARE EARTHS.

G.S.Anderson and S.Legvold.

Phys. Rev. Letters, Vol. 1, No. 9, 322-4 (Nov. 1, 1958).

It is suggested that the depression of the superconducting transition temperature T_c of La on alloying with rare earth metals (Abstr. 7980/1958) is due to changes in the effective electron–electron interaction, V, which may arise from exchange interactions between conduction electrons and magnetic ions. An empirical formula for V as a function of the concentration and spin of the solute atoms is substituted in the formula for T_c given by Bardeen, Cooper and Schrieffer (Abstr. 1708/1958). Good agreement with the experimental data is obtained. D.M.Edwards

537.312.62

4623. EXCHANGE SCATTERING IN SUPERCONDUCTORS.

H.Suhl and B.T.Matthias.

Phys. Rev. Letters, Vol. 2, No. 1, 5-6 (Jan. 1, 1959).

Criticizes a theory put forward by Anderson and Legvold (preceding abstract) to explain the depression of the transition temperatures of La when alloyed with Gd, and outlines an alternative explanation, in which exchange scattering by the 4f electrons lowers the energy of the normal state. R.G.Chambers

537.312.7

4624. STUDY OF THE MAGNETORESISTANCE OF THIN EVAPORATED NICKEL FILMS.

T.Rappeneau.

Cahiers de Phys., Vol. 12, 185-237 (May-June, 1958). In French.

Films with thicknesses (e) in the range 360-720 A were investigated at room temperature. The work described with full experimental details includes studies of the evolution of the resistance after evaporation and the temperature dependence of the resistivity after annealing as well as the magnetoresistance measurements. The sense of evolution of the resistance was negative for the thicker films (e > 480 A) and positive for the thinner films (e < 480 A). This is attributed to different film structures. Only the thicker film appear ferromagnetic, showing an anomaly in the resistance–temperature curve similar to that for the bulk metal. The magnetoresistance measurements are for (a) small fields (0-360 Oe), and (b) saturation fields up to 8000 Oe. In the range (a) only the films with e > 480 A show a variation in resistance. The curves obtained are similar to those for bulk nickel and indicate the existence of domains. The results give information about the process of magnetization and the variations of magnetic structure with thickness. In the range (b) the magnetoresistance has been studied as a function of the angle between the field and the current and as a function of the applied field. There is an anisotropy in the decrease of resistance with field which is interpreted theoretically. D.M.Edwards

537.312.7

4625. HALL EFFECT FOR ELECTRONS IN SILVER CHLORIDE.

K.Kobayashi and F.C.Brown.

Phys. Rev., Vol. 113, No. 2, 507-13 (Jan. 15, 1959).

The Hall mobility of photoelectrons was measured down to 5°K in single crystals of silver chloride. The experiment was carried out with a pulse technique which overcomes the difficulties of space charge and high impedance common to such measurements on insulating crystals. Results show that the electron Hall mobility rises to high values, $6000\ cm^2/V^{-1}sec^{-1}$ at very low temperature. On the other hand, drift mobility is strongly influenced by multiple trapping and is not characteristic of microscopic mobility in these crystals at low temperature. Comparison with mobility theory indicates that electrons are scattered by both the optical and acoustical modes of lattice vibration depending upon the range of temperature. Evidence for a structure-dependent scattering such as would be produced by impurities is found below 20°K. Magnetoresistance effects begin to become important at high values of mobility and magnetic field in qualitative agreement with the theory of electronic conductivity for a cubic crystal with simple energy bands and nondegenerate statistics.

537.312.8

4626. MAGNETIC PROPERTIES OF VERY THIN NICKEL FILMS.
G.Goureaux and A.Colombani.
C.R. Acad. Sci. (Paris), Vol. 248, No. 4, 543-6 (Jan. 26, 1959).
In French.

The Hall voltage of very thin films suffers a sign reversal at magnetic field strengths which decrease on decreasing the thickness. The extraordinary coefficient reaches a maximum and the ordinary coefficient a minimum at about 100 A. The results are discussed in terms of d-band hole conduction. E.P.Wohlfarth

537.312.8

4627. THE PHENOMENOLOGICAL THEORY OF THE GALVANOMAGNETIC EFFECT. T.Okada.
Mem. Fac. Sci. Kyusyu Univ. B, Vol. 1, No. 5, 157-68 (Sept., 1955).

An analysis is made for crystals of the eleven types of Laue symmetry which can be constructed by rotatory operation. The tensor forms of the Hall effect and the transverse and longitudinal magnetoresistance are given, with a more detailed calculation for the trigonal crystal. An experimental procedure is described for determining all the components of the tensors up to the third order. C.Hilsum

537.312.8

4628. MAGNETIC FIELD DEPENDENCE OF THE HALL EFFECT AND MAGNETORESISTANCE IN GRAPHITE SINGLE CRYSTALS.
D.E.Soule.
Phys. Rev., Vol. 112, No. 3, 698-707 (Nov. 1, 1958).

The Hall coefficient and magnetoresistance in purified (99.995%) natural graphite single crystals were measured from 25 to 25 000 G at 298°, 77°, and 4.2°K with the field oriented parallel to the hexagonal axis. Special care was taken in the micromanipulation and strain-free mounting of these small soft crystals. Fast minority carriers due to Fermi-surface warping were discovered by their effect on the low-field Hall coefficient behaviour. The compensating effect between the majority electron and hole densities $[(5-2) \times 10^{18}$ cm^{-3} with $n_e/n_h = 1.0\text{-}1.15$ over the above temperature range] and mobilities $[(1.5\text{-}130) \times 10^4\ \mathrm{cm}^2\ \mathrm{V}^{-1}\mathrm{sec}^{-1}$ with $\mu_e/\mu_h = 1.10\text{-}0.79]$ makes the Hall coefficient very sensitive to the temperature, impurities, and field where it even changes sign. A quadratic low-field room-temperature magnetoresistance dependence progresses at higher fields to an impurity-insensitive $H^{1.78}$ behaviour. The large magnetoresistance ratio of graphite ($\sim 10^5$ at 4.2°K and 23 kG), along with the appearance of de Haas–van Alphen type oscillations in these properties, demonstrates the small effective masses ($0.03m_0$, $0.06m_0$) and long relaxation times (2.5×10^{-11} sec at 4.2°K). The mobility follows a $T^{-1.2}$ law in the lattice-scattering region $> \sim 50$°K. Low-temperature results, showing carrier density differences and mobilities to be most sensitive to impurities, substantiate the relatively high purity of these crystals.

537.312.8

4629. ANALYSIS OF GALVANOMAGNETIC DE HAAS–VAN ALPHEN TYPE OSCILLATIONS IN GRAPHITE.
D.E.Soule.
Phys. Rev., Vol. 112, No. 3, 708-14 (Nov. 1, 1958).

An analysis is made of oscillations in the Hall effect and magnetoresistance for graphite single crystals at 4.2°K with the field parallel to the hexagonal axis. Two periods of $2.11 \times 10^{-5}\ \mathrm{G}^{-1}$ and $1.58 \times 10^{-5}\ \mathrm{G}^{-1}$ are shown to be due to the majority electrons and holes, respectively. These same two values were found in both galvanomagnetic effects and are in reasonable agreement with those observed in the susceptibility. There is a phase difference of π between the two galvanomagnetic properties. An analysis of the magnetic field dependence of the amplitude incorporating both effects in a "galvanomagnetic ratio", ρ/R, is made giving effective-mass values of $0.03m_0$ for the electrons and $0.060m_0$ for the holes. These are in substantial agreement with those calculated from cyclotron resonance and from the temperature dependence of the susceptibility de Haas–van Alphen oscillations. Corresponding Fermi energies were found to be 0.018 eV for the electrons and 0.012 eV for the holes, giving a very slight band overlap in graphite of 0.030 eV.

537.312.8

4630. ANALYSIS OF MULTICARRIER GALVANOMAGNETIC DATA FOR GRAPHITE. J.W.McClure.
Phys. Rev., Vol. 112, No. 3, 715-21 (Nov. 1, 1958).

The magnetic-field-dependent data of Soule for the Hall effect and magnetoresistance in graphite (see preceding two abstracts) is analysed using a multicarrier model. An improved mode of analysis is used, in which the magnetoconductivity tensor elements are computed as functions of magnetic field strength from experimental data, and then fitted to simple formulae. The formulae represent solutions to the Boltzmann equation in the classical (nonoscillator range. The effects of electrons and holes are separated by applyi a Kramers–Kronig type relation. The results, which agree with band-model predictions within 20 to 50%, are that there are 2.9×10^{18} holes and electrons/cm^3 in pure graphite at 4.2°K, and $7.0 \times 10^{18}\ \mathrm{cm}^{-3}$ each at 300°K. The mobilities range from about $9 \times 10^5\ \mathrm{cm}^2\ \mathrm{V}^{-1}\ \mathrm{sec}^{-1}$ at 4.2°K to $1.0 \times 10^4\ \mathrm{cm}^2\ \mathrm{V}^{-1}\ \mathrm{sec}^{-1}$ at 300°K with the hole-to-electron mobility ratio being 1.2 and 0.9 at the tw temperatures. In addition, at room temperatures there are about 6×10^{14} minority holes/cm^3 with a mobility of $15 \times 10^5\ \mathrm{cm}^2\ \mathrm{V}^{-1}$ sec^{-1} and 5×10^{14} minority electrons/cm^3 with a mobility 4×10^5 $\mathrm{V}^{-1}\ \mathrm{sec}^{-1}$. The relaxation times for the majority carriers are distributed over a range of a factor of four. The average relaxation times are consistent with those deduced from cyclotron resonance experiments.

537.312

4631. GALVANOMAGNETIC PROPERTIES OF GALLIUM AT LOW TEMPERATURES. J. Yahia and J.A.Marcus.
Phys. Rev., Vol. 113, No. 1, 137-46 (Jan. 1, 1959).

Gallium single crystals were investigated in a transverse magnetic field at helium temperatures, 77 and 290°K. At 290 and 77°K the galvanomagnetic properties are described according to a set of phenomenological equations, these properties then being specified the tensors in the equations. This formalism breaks down at heliu temperatures, where an apparent reduction in crystal symmetry occurs; the number of coefficients specifying the magnetoresistivit tensor according to crystal symmetry considerations is insufficien for a description of the observed galvanomagnetic properties. The results at helium temperatures can be qualitatively understood in terms of the recent fundamental theory of galvanomagnetic effects Lifshitz, Azbel', and Kaganov which is based on considerations invo ing the topology of the Fermi surface. The anomaly of a marked di placement of the maximum in the Hall rotation curve at 77 and 290° is accounted for in detail according to the phenomenological formalism, on the basis of the anisotropy of the Hall coefficients at those temperatures combined with a small displacement of crystallograp axes from specimen axes. Well-defined oscillations in the magnet resistance and Hall effects, superposed on the monotonic variation the effects, have been observed for every crystal orientation studie The general characteristics of these oscillations are the same as those in the diamagnetic susceptibility (the de Haas–van Alphen effects).

537.312.8 : 539.8

4632. EFFECT OF HYDROSTATIC PRESSURE ON THE ANOMALOUS HALL COEFFICIENT REVERSAL IN SINGLE CRYSTAL TELLURIUM. A.Nussbaum, J.Myers and D.Long.
Phys. Rev. Letters, Vol. 2, No. 1, 6-7 (Jan. 1, 1959).

Measurements were made from 290 to 570°K at atmospheric pressure and at 2000 atm pressure. The upper reversal temperatu is 246°C and this is raised 16 deg by the added hydrostatic pressure This reversal temperature also depends on the impurity concentration of the Te. C.A.Hogarth

537.312.8

4633. THE DETERMINATION OF THE CURIE TEMPERATURE OF THIN FILMS BY MEANS OF THE MAGNETORESISTANCE EFFECT. W.Hellenthal.
Z. Naturforsch., Vol. 13a, No. 7, 566-7 (July, 1958). In German.

Describes measurements on films of varying thickness, the results being extrapolated to give the result for bulk material. A. E. De Barr

537.32

4634. THERMOELECTRICITY. D.S.Lieberman.
Phys. Today, Vol. 12, No. 2, 26-9 (Feb., 1959).

This is a report of a conference which was held on September 3-4, 1958 in Washington, D.C. The problems discussed were mainly related to the development of thermoelectric materials, especially for power generation and cooling.

537.32

4635. PHYSICAL PROBLEMS OF THERMOELECTRICITY.
A.F.Joffe and L.S.Stil'bans.
Rep. Progr. Phys., Vol. 22, 167-203 (1959).

The interest in thermoelectric phenomena and in their practical applications led to an investigation of semiconductors with high electric conductivities σ and low thermal conductivities κ. The requirement of the highest possible ratio of the mobility U to κ directed attention to solid solutions. κ could be decreased to values corresponding to a free path of phonons of a few interatomic distances. The replacement of positive ions in a compound by analogous ions (for instance Bi by Sb in Bi_2Te_3 or Pb by Sn in PbTe) decreases many times the mobility of electrons, while the mobility of holes remains unaltered. A distortion of the sub-lattice of negative ions leads to a decrease of the mobility of holes. The influence of impurities on the free path of phonons and of free charge carriers reveals the scattering cross-section of defects. Crystal lattices with a proportion of unfilled sites have exceptionally short free paths which, calculated in the usual way, are smaller than the periods of the lattice. Accordingly the mobility increases with rising temperature. Using degenerate systems of free charge carriers it became possible to separate the influence, on the mechanism of scattering, of the velocity of electrons on one hand, and of the thermal motion of the lattice on the other. The onset of intrinsic conduction introduces an additional thermal conductivity due to the diffusion of electron—hole pairs. Excitons, with small excitation energies, have an analogous effect. The high transparency of pure semiconductors to radiation with $h\nu < E_0$ brings into action a heat conduction mechanism, due to the transmission of infrared radiation, as long as absorption by impurities or by free charges does not stop the radiation. The dragging of phonons and electrons increases both the thermal conductivity and the thermoelectric power at low temperatures. The materials selected for thermoelectric devices are investigated in detail.

537.321 : 537.533.47

4636. THERMOELECTRIC POWER AND ELECTRON SCATTERING IN METAL ALLOYS. C.A.Domenicali.
Phys. Rev., Vol. 112, No. 6, 1863-76 (Dec. 15, 1958).

A phenomenological theory of thermoelectric power in binary, ternary, and more complex noble-metal base alloys is presented, which is based on the well-known thermoelectric power formula of Mott and others. The temperature dependence of certain scattering coefficients leads to information on the variation of scattering cross-section with electron kinetic energy; the simple model described appears to be internally consistent and furnishes considerable insight into the nature of electron scattering from point imperfections in metals. It is found from an experimental study of the series of solutes Cr, Mn, Fe, Co, and Ni in copper, that the cross-section depends on electron energy in a manner closely resembling that of the Ramsauer—Townsend effect in slow-electron scattering from atoms in the vapour state. The theory is used to predict the behaviour of ternary and more complex alloys from information on binary alloys. Experiments on selected ternary solid solutions are described. The results are in accord with predictions of the theory.

537.321

4637. THE ABSOLUTE SCALE OF THERMOELECTRIC POWER AT HIGH TEMPERATURE. N.Cusack and P.Kendall.
Proc. Phys. Soc., Vol. 72, Pt 5, 898-901 (Nov., 1958).

A combination of measurements now available in the literature allows the absolute thermoelectric power

$$S = \int_0^T \frac{\sigma_T}{T}\, dT$$

(where σ_T is the Thomson coefficient) to be tabulated for several high melting point metals up to high temperatures. M.R.Hopkins

537.323 : 536.48

4638. ON THE VARIATION WITH MAGNETIC FIELD OF THE THERMOELECTRIC EFFECT IN Ge SINGLE CRYSTALS AT LOW TEMPERATURES. J.Erdmann, H.Schultz and J.Appel.
Z. Naturforsch, Vol. 12a, No. 2, 171-4 (1957). In German.

Reports measurements of Hall effect, resistivity, transverse thermoelectric effect and thermal conductivity of a sample of n-germanium in magnetic fields up to 17 kilogauss and at temperatures down to 10°K. The results obtained are discussed in relation to lattice and electron contributions. A.E.De Barr

537.323

4639. AN EXPERIMENTAL CONTRIBUTION ON THE THERMO-E.M.F. OF THIN EVAPORATED FILMS. L.Reimer.
Z. Naturforsch., Vol. 12a, No. 6, 525-6 (1957). In German.

An experimental investigation of films of various metals against a Cu film 4000 A thick, and of the dependence of the thermo-e.m.f. on film thickness. M.R.Hopkins

537.323 : 538.69

4640. THE MAGNETOTHERMOELECTRIC EFFECT IN GERMANIUM AT LOW TEMPERATURES. J.Erdmann.
Z. Naturforsch., Vol. 13a, No. 8, 650-62 (Aug., 1958). In German.

Gives the results of measurements in the range 20-90°K of the thermoelectric effect in a transverse magnetic field in single crystals of n- and p-type germanium with various impurity concentrations. The conclusions reached are: (1) the variation of the thermoelectric effect with the magnetic field is similar to that of the magnetoresistance effect; (2) the increasing influence of scattering by ionized impurities leads to a diminution of the thermoelectric e.m.f. The anisotropy of the magnetothermoelectric effect is discussed in relation to theoretical predictions. A.E.De Barr

ELECTRIC DISCHARGES

537.52 : 621.372.837.2 : 621.387

4641. EFFECTIVENESS OF THE AUXILIARY DISCHARGE IN WIDE-BAND TR-TUBES AS A FUNCTION OF POSITION OF THE KEEP-ALIVE ELECTRODE. G.N.Golubchin and A.M.Starik.
Zh. tekh. Fiz., Vol. 27, No. 9, 2089-91 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 1935-7 (Sept., 1957).

The dependence of keep-alive loss and "spike" energy of wide-band TR-tubes for the 10 cm region on keep-alive electrode position is determined. The role of the cathode parts of the glow discharge is discussed.

537.521 : 621.387

4642. INITIATION OF PULSED DISCHARGE IN ARGON AT ULTRA-HIGH FREQUENCIES. III. INITIATION OF THE DISCHARGE UNDER THE ACTION OF AN EXPONENTIALLY INCREASING HIGH-FREQUENCY POWER. V.E.Golant.
Zh. tekh. Fiz., Vol. 27, No. 9, 2071-9 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 1919-26 (Sept., 1957).

On the basis of results of the analysis of the velocity distribution function of the electrons, as given in earlier papers (Abstr. 4040-1/1958), a calculation is made of the change of amplitude of the electric field intensity in the discharge gap at the initiation of a discharge in argon under the action of an exponentially increasing high-frequency power. Parameters are found which characterize the process of initiation of the discharge. Results of calculations are compared with experimental data available in the literature on the characteristics of the peak power getting through the discharge gaps of discharge protective devices used with receivers of radar apparatus.

537.521.6

4643. SIGNIFICANCE OF FORMATIVE TIME LAGS IN GASEOUS BREAKDOWN. L.B.Loeb.
Phys. Rev., Vol. 113, No. 1, 7-12 (Jan. 1, 1959).

Delineating formative time lag studies of gaseous breakdown as conventionally carried out, this type of investigation is analysed as it applies to two breakdown types. These are (1) the breakdown thresholds set by the generic Townsend relation, in many instances difficult to detect, but for which time scales observed delineate the well-established atom physical mechanisms active; (2) the more dramatic transient spark-like breakdowns, involving appearance of negative resistance characteristics caused by alterations of the gas, the electrodes, or space charge disposition of an unpredictable character. On this basis, the various breakdown phenomena known are listed and characterized as to their amenability to profitable time lag studies. It is further indicated that in contrast to time lag studies, the fast oscilloscopic analysis of breakdowns delineating transient current, potential, and luminosity as a function of space and time can prove invaluable and areas requiring this type of analysis are indicated.

537.521.7

4644. ELECTRIC STRENGTH, MOLECULAR STRUCTURE, AND ULTRAVIOLET SPECTRA OF HYDROCARBON GASES.
A.E.D.Heylen.
J. chem. Phys., Vol. 29, No. 4, 813-19 (Oct., 1958).

Previous careful measurements (Abstr. 200/1958) of the sparking potential of a number of hydrocarbon gases over a wide range of pressures and a fixed electrode spacing were extended to cover olefines which involve methyl substitution around the ethylenic double bond. The effect of cyclization in a mono-olefine and of methyl substitution in a diene were also included with measurements in cyclopentene and isoprene. Using an established Townsend-like expression for the ionization coefficient α and for the sparking potential, the molecular parameter B, a constant in the expression for α, can be determined for each gas. This constant can be directly related to molecular structure and to mean electron—molecule scattering cross-sections. Thus the influence on B of CH_3 and CH_2 groups and chromophoric groups involving double and triple bonds can be assessed and cross-section values determined accordingly. These prove to be independent of methyl substitution. Information from ultraviolet absorption spectra furnishes supporting evidence for this model which should make it possible to correlate the sparking potentials of a larger range of hydrocarbons than hitherto.

537.523

4645. A THEORY OF THE SUCCESSIVE PRODUCTION OF MOVING STRIATIONS IN THE PLASMA OF INERT GASES. L.Pekárek.
Czech. J. Phys., Vol. 7, No. 5, 533-56 (1957).

The theory proposed to explain previously observed (Czech. J. Phys., Vol. 4, No. 2, 221, 1954) transient moving striations (waves of stratification) produced in a plasma by external perturbations is elaborated. Equations are derived for the spatial and temporal development of striations on the assumption that the initial perturbation increases the electron temperature near the cathode; this causes an increased positive space charge there which in turn reduces the field on the anode side of the region, so producing an adjacent region of negative space charge and so on. The development of the striations depends on the fundamental processes involved in the disturbance of the plasma and its return to normal; possible processes in Ne are discussed. J.Dutton

537.523

4646. OBSERVATIONS ON COUPLED LOW PRESSURE DISCHARGES IN ARGON. K.Rademacher and K.Wojaczek.
Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 1-2, 57-67 (1958).
In German.

An experimental study was made of the variations in burning voltage and light output from crossed coupled discharges (currents ~ amps) in a cross shaped discharge tube. It is shown that striations exist in a section of a positive column only if the current in this section falls below a limiting value i_G, and that the effect of a disturbance of a region of the plasma dies out in a shorter distance towards the cathode than towards the anode. J.Dutton

537.523

4647. ON ARTIFICIAL PRODUCTION OF MOVING STRIATIONS IN THE ARGON LOW PRESSURE DISCHARGE. K.Wojaczek.
Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 1-2, 68-80 (1958).
In German.

Continuation of previous work using the same apparatus (see previous abstract). Artificial striations were produced in a positive column (current $> i_G$) by a modulated cross-discharge. The effect of the modulation frequency on the amplitude and dispersion of the striations was investigated and discussed in terms of a theory previously proposed by Pekárek, Abstr.4645 (1959). In certain conditions the natural striation frequency is found to be one quarter of the collision frequency of electrons for ionizing collisions. J.Dutton

537.523.3 : 537.525.3

4648. WIRE—CYLINDER ELECTRIC DISCHARGES IN AIR IN RELATION TO THE SPACE-CHARGE FIELD EMISSION HYPOTHESIS. H.Ritow.
J. Electronics and Control, Vol. 5, No. 3, 193-225 (Sept., 1958).

A very detailed study of wire-cylinder corona in air. Most of the data — onset voltages, field at the wire surface at corona initiation, etc. — refer to atmospheric pressure, but data are also given for the pressure range 2.0 mm Hg up to 1 atm. The author examines this comprehensive collection of data (presented in tabular and graphical form) in the light of his suggestion that field emission, caused by negative ion space charge fields for positive wires, and positive ion space charge fields for negative wires, is responsible for the initiation of glow flashes, i.e., intermittent glow discharges. J.D.Craggs

537.523.4

4649. EFFECT OF RADIATION ON THE BREAKDOWN OF HOMOGENEOUS FIELD AND SPHERE GAPS. K.R.Allen and K.Phillips.
Nature (London), Vol. 183, 233-5 (Jan. 24, 1959).

Describes sparking rates, with a stabilized d.c. source, in atmospheric nitrogen for 1 and 2 cm uniform field gaps and an 0.975 cm gap between 5 cm diameter spheres, with and without Ra irradiation. The reduction in breakdown voltages due to irradiation was greater for the sphere gap. The results are briefly discussed in terms of the Toepler discontinuity, etc. J.D.Craggs

537.523.

4650. AN INVESTIGATION OF ANOMALOUS ROTATION OF ARCS. H.Pupke.
Exper. Tech. der Phys., Vol. 2, No. 3, 128-9 (1954). In German.

Briefly enumerates certain properties of arcs in normal and ir abnormal rotation regimes. No definite explanation of the retrogra motion is advanced. J.D.Cragg

537.523.

4651. ARC CATHODE MOVEMENT IN A MAGNETIC FIELD. A.E.Guile and P.E.Secker.
J. appl. Phys., Vol. 29, No. 12, 1662-7 (Dec., 1958).

An arc cathode spot in a transverse magnetic field may move either in the Amperian (forward) direction, or in the opposite (retro grade) direction. Experiments are described which show that forward continuous motion is caused by magnetic fields at the cathode surface, as is the case with retrograde motion, and that both of thes motions depend upon the material and surface condition of the catho Forward cathode velocity both when continuous and when moving in a stepping process is independent of arc current over a wide range. The theories so far suggested for retrograde motion do not appear to be able to account for the dependence of retrograde cathode move ment on the nature of the cathode surface.

537.525 : 539.17 : 621.039 : 621.387

4652 PHYSICAL MEASUREMENTS ON HEAVY-CURRENT DISCHARGES. R.M.Payne and S.Kaufman.
Proc. Instn Elect. Engrs, Paper 2900 [Convention on Thermonuclear Processes], publ. April, 1959, 7 pp. To be republished in Vol. 106A (1959).

An understanding of heavy-current discharges entails extensive measurement of the plasma. A review is given of some measurements with particular reference to the thermonuclear apparatus Sceptre III, although one of the categories of measurement is applicable to any hot gas containing deuterium. Emphasis is placed on instrumentation and on the physical basis of measurement. Limitations of and improvements to the methods and the modifications to be anticipated when the plasma temperature rises are indicated. Result of measurements not previously published, such as those on discharge stability and energy loss, are included. Although few of the measurements are completely reliable, several independent methods of measurement can yet provide a self-consistent and hence more trustworthy result. New methods of measurement are desirable to extend the present range.

537.525 : 621.387 : 621.039

4653. CHOICE OF MATERIALS AND PROBLEMS OF DESIGN OF HEAVY-CURRENT TOROIDAL DISCHARGE TUBES. A.E.Robson and R.Hancox.
Proc. Instn Elect. Engrs, Paper 2948 [Convention on Thermonuclear Processes], publ. April, 1959, 9 pp. To be republished in Vol. 106A (1959).

One of the principal problems of heavy-current discharges is the contamination of the plasma by material eroded from the walls of the discharge tube. Erosion may occur by thermal evaporation, sputtering and — in the case of metal walls — the formation of arcs. These processes are examined in detail, with particular reference to the conditions which may exist in a thermonuclear reactor working on the pinched-discharge principle. It appears that, for stable discharges of long duration, thermal evaporation and sputtering should not be serious if materials of low atomic number are used. In the more severe transient initial conditions, sputtering may limit the duration of the first stage of the discharge. Metals are superior to insulators in thermal properties and ease of fabrication, but tend to form "unipolar" arcs when exposed to plasma. The mechanism of these arcs is discussed, and some experiments on the arcing properties of different materials are described. A review is given of a number of possible torus designs.

537.525.4 : 621.319.51

4654. HIGH-POWER VACUUM SPARK GAP. D.C.Hagerman and A.H.Williams.
Rev. sci. Instrum., Vol. 30, No. 3, 182-3 (March, 1959).

The design and construction of a voltage graded vacuum spark gap is described. This gap is capable of switching currents as large as 10^6 A at voltages up to 75 kV. The effect of the insulating walls of the gap is briefly discussed.

537.525.5

4655. AN EXPERIMENTAL STUDY OF SPONTANEOUS OSCILLATIONS IN HOT CATHODE MERCURY VAPOUR TUBES. M.Hoyaux and P.Gans.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 42, No. 9, 961-70 (1956).
In French.

Briefly describes, with references, a method for determining electron densities, electron temperatures and space potentials as a function of time for an a.c. low pressure discharge tube (in the present case Hg vapour). Current fluctuations ("hash") arising in the anode region were observed and are discussed. J.D.Craggs

537.525.8

4656. INFLUENCE OF A HIGH-FREQUENCY FIELD ON THE STRATIFICATION [STRIATIONS] IN A GLOW DISCHARGE.

M.Šícha.

Czech. J. Phys., Vol. 8, No. 4, 490 (1958). In Russian.

537.525.92

4657. EFFECT OF SPACE CHARGE IN COLD-CATHODE GAS DISCHARGES. A.L.Ward.

Phys. Rev., Vol. 112, No. 6, 1852-7 (Dec. 15, 1958).

Townsend's basic ionization equations for cold-cathode gas discharges between parallel plates are modified by Poisson's equations to account for space-charge effects. Numerical calculations have been made for argon on the I.B.M. 704 computer. Calculated voltage current static characteristics in general show a negative slope region indicating "breakdown". For low pd products (p being the gas pressure and d the gap distance), a second region of positive slope (abnormal glow) is obtained at higher currents. The electric field distribution across the gap is shown, at high currents, to approach that measured in glow discharges, and the formation of a positive column plasma is indicated by the charge distributions.

537.528

4658. ASPECTS OF ELECTRICAL BREAKDOWN OF LIQUID INSULATING MATERIAL. I. J.A.Kok and M.M.G.Corbey.

Appl. sci. Res. B, Vol. 7, No. 4, 257-64 (1958).

The electrical breakdown strength of insulating oil depends on the size of foreign particles which may form bridges in a place of maximum electric stress. This was verified with colloid suspensions of particles of known radius. Mineral oils may deteriorate if the particles unite by the process of flocculation, the occurrence of which depends on the relative magnitudes of the attractive London—Van der Waals forces acting between the particles,and the repulsive forces between their ion atmospheres. The possibility of using a mineral oil as an insulator depends on the existence of an upper limit of the size of particle complexes due to the rapid fall-off of the London—Van der Waal forces at diameters exceeding 500 A. The latter value of 2r corresponds to a breakdown strength of 1 kV/mm. If acids are being formed, the upper limit of 500 A will shift towards larger values, and correspondingly the breakdown strength may drop below 1 kV/mm.

537.529 : 537.226.2

4659. TEMPERATURE DEPENDENCE OF THE BREAKDOWN FIELD OF BARIUM TITANATE. P.H.Fang and W.S.Brower.

Phys. Rev., Vol. 113, No. 2, 456-8 (Jan. 15, 1959).

The d.c.breakdown field was measured for ceramic $BaTiO_3$ as a function of the ambient temperatures. The breakdown field shows, in general, a temperature dependence of the thermal breakdown type where the breakdown field decreases as the temperature is increased. However, in addition to this general behaviour, the breakdown field dips down strongly and shows minima at the critical temperatures of the phase transformations. This seems to indicate a process of polarization breakdown, and is most pronounced near the orthorhombic-tetragonal transition temperatures.

537.529

4660. ON WIRE EXPLOSIONS WITH INTERRUPTED WIRES.

W.M.Conn.

Z. Naturforsch., Vol. 13a, No. 4, 355-6 (April, 1958). In German.

See Abstr. 8017 (1958). The case of a wire projecting at right angles from a metal plate is considered. J.M.Hough

537.529

4661. THE EFFECT OF ELECTRODE MATERIAL AND THERMAL TREATMENT OF SAMPLES ON THE ELECTRIC STRENGTH OF ALKALI-HALIDE CRYSTALS.

E.A.Konorova and L.A.Sorokina.

Zh. tekh. Fiz., Vol. 28, No. 8, 1676-8 (1958). In Russian.

At temperatures higher than 100°C the electric strength of alkali-halide crystals depends on the electrode material (the electric strength is higher with the gold than with silver electrodes). The effect of thermal treatment of the sample, prior to deposition of electrodes, on the temperature dependence of breakdown strength is smaller than the effect of electrode material. Z.Krasucki

X-RAYS

537.531

4662. ACCIDENT AND PROFESSOR RÖNTGEN. A.Romer.

Amer. J. Phys., Vol. 27, No. 4, 275-7 (April, 1959).

Though his own paper is wonderfully clear, the circumstances under which Röntgen discovered X-rays are completely obscure. Contemporary accounts are few, uninforming, and unreliable. It is certain that Röntgen was working with Lenard rays in the summer of 1894, but he seems to have made little use of Lenard's special equipment when working with X-rays in the autumn of 1895. Röntgen's discovery amounts to more, however, than the observation of the rays; it includes also his thorough exploration of their properties.

537.531 : 535.822.1 : 778.33

4663. A CRITICAL COMPARISON OF PROJECTION MICRORADIOGRAPHY AND THE 2X METHOD.

Ong Sing Poen and J.B.Le Poole.

Appl. sci. Res. B, Vol. 7, No. 4, 265-9 (1958).

It is shown that Cosslett's criticism of the 2X method (see Abstr. 1825/1957) is based partly on a misconception of the resolving power of the photographic film and partly on a fundamentally wrong comparison between the projection and the 2X methods. A generally valid comparison is given for the cases where the resolving power is not limited by Fresnel diffraction. It is shown that Fresnel fringes are smaller in the 2X method than in a comparable projection system.

537.531

4664. EXCITATION OF CHARACTERISTIC K X-RAYS BY THE IMPACT OF HEAVY CHARGED PARTICLES.

D.Jamnik and Č.Zupančič.

K. Danske Vidensk. Selsk. mat.-fys. Medd., Vol. 31, No. 2, 15 pp. (1957).

The cross-section for ejection of K-electrons by slow ions is evaluated in the Born approximation for the incident particles, using relativistic electron wave-functions. Numerical results are given for lead (and silver) and compared with experimental cross-sections for excitation of characteristic K X-rays. For silver, the relativistic corrections are small, but for lead they are appreciable and improve the agreement with experiment. The theoretical cross-sections for Pb as well as for Ag are not in quantitative agreement with the experimental values. The discrepancy is attributed mainly to a failure of the Born approximation.

537.531 : 535.3

4665. $M_{2,3}$ EMISSION BAND OF COPPER.

D.E.Bedo and D.H.Tomboulian.

Phys. Rev., Vol. 113, No. 2, 464-70 (Jan. 15, 1959).

The copper $M_{2,3}$ band was investigated in connection with a sequential study of the $M_{2,3}$ emission and absorption spectra of the 3d transition metals. The characteristic band is superimposed on a continuous spectrum emitted by the target and the paper describes the procedure for removing the effect of this background. Other experimental considerations dealing with such effects as the instrumental window, self-absorption, the presence of contaminants, and the nature of the target layer are included. Where possible, an assessment is made of the distortion produced by such factors in the shape of the band. The photometrically determined $M_{2,3}$ intensity contour is compared with recent work based on detection schemes utilizing photon counters. On the basis of certain assumptions the composite $M_{2,3}$ distribution is decomposed into individual M_2 and M_3 curves, whose behaviour at the high-energy end of the spectrum is in good agreement with previously available data on the individual absorption edges. Features of the $I(E)/\nu^2$ distribution belonging to the M_3 band are as follows: the band has a maximum at 72.0 eV (172 A) and excluding satellite structure and tailing effects has a width of 7.8 eV. At the high-energy end, the intensity rises gradually and no sharp structures are noticeable. Except for the satellite structure, no inconsistencies arise when the results on the M_3 band (valence → 3p) are compared with those on the L_3 band (valence → 2p)

537.531 : 535.3

4666. X-RAY K-ABSORPTION SPECTRA OF SOLID ARGON AND KRYPTON. J.A.Soules and C.H.Shaw.

Phys. Rev., Vol. 113, No. 2, 470-2 (Jan. 15, 1959).

The X-ray K-absorption edge structures of argon (at 3.86 A) and of krypton (at 0.86 A) were measured in the gaseous and solid states. The spectra of the gases confirm previous work. The spectra of the solids exhibit pronounced structure extending far to the short-wavelength side of the absorption edge. The broad absorption maxima observed can be correlated with the valence bands in the crystal, but the extremely sharp initial rise requires an unusual density of states in the bands, perhaps offering evidence for the existence of excitation states.

537.531 : 535.3

4667. IMPROVED MEASURING APPARATUS FOR X-RAY ABSORPTION SPECTROMETRY.

H.P.Hanson, W.E.Flynt and J.E.Dowdey.

Rev. sci. Instrum., Vol. 29, No. 12, 1107-11 (Dec., 1958).

Two techniques for simplifying data taking and for eliminating the requirement of a carefully stabilized X-ray power supply in X-ray absorption spectrometry were developed. Method I oscillates the sample in and out of the beam with a period that is small compared to drift and the usual X-ray tube instabilities. The corresponding I and I_0 are channelled to two ratemeters, and by analogue techniques a quantity proportional to the absorption coefficient is electronically calculated and plotted. In method II, two counters are arranged in tandem with the sample between, yielding I and I_0 simultaneously. The proper apportionment of counts in both arrangements is considered.

537.531 : 535.3

4668. USE OF POLYSTYRENE AS AN X-RAY ABSORBER — THE MASS ABSORPTION COEFFICIENT OF CARBON.

B.W.Batterman.

Rev. sci. Instrum., Vol. 29, No. 12, 1132 (Dec., 1958).

The advantages of using polystyrene as an X-ray absorber are pointed out. The measured linear absorption coefficient for both commercial rod and high-purity moulded sheet was found to be 4.165 ± 0.008 cm^{-1} for CuK$_\alpha$ radiation. The mass absorption coefficient of carbon (μ_l/ρ) is 4.301 ± 0.009 cm^2/g. This value is compared to other published results.

537.531 : 535.33.072

4669. A CRYSTAL HOLDER FOR FOCUSING X-RAY SPECTROGRAPHS WITH A CONTINUOUSLY ADJUSTABLE RADIUS OF CURVATURE.

J.Scharschmidt.

Z. Naturforsch., Vol. 13a, No. 4, 356-7 (April, 1958). In German.

The disadvantages of employing a cylindrical metal segment, against which the crystal plate is pressed, are overcome by bending the crystal plate through the direct action of four steel rollers, no metal backing plate being involved. Pressure is applied through a micrometer screw, by which the radius of curvature can be adjusted to any desired value. The apparatus is designed for use with a quartz crystal plate of dimensions 40 × 30 × 0.2 mm. J.Thewlis

537.531 : 535.4 : 539.2

4670. THE PRODUCTION OF KIKUCHI LINES AND BANDS WITH RELATIVELY WEAK X-RAYS AND THE INFLUENCE OF CRYSTAL DISTORTIONS ON THESE X-RAY INTERFERENCES.

O.Brümmer.

Z. Naturforsch., Vol. 13a, No. 7, 571-2 (July, 1958). In German.

Some examples are given of photographs obtained using a divergent beam from a fine-focus X-ray tube, operated at 30-50 kV, and making use of the short wavelength limit of the bremsstrahlung. A.R.Stokes

537.531 : 535.3

4671. ON THE STRUCTURE OF THE SOFT X-RAY EDGE AT CONSTANT WAVELENGTH FOR TUNGSTEN.

K.Ulmer and H.Vernickel.

Z. Phys., Vol. 153, No. 2, 149-57 (1958). In German.

An applied voltage of 1.25 kV was used, and a line breadth of 2 volts at about 4 volts from the edge was found. An explanation can be given in terms of the energy band structure of tungsten. J.M.Hough

537.531.08

4672. DERIVATION OF THE EFFECTIVE X-RAY ENERGY IN A MATERIAL FROM IONIZATION MEASUREMENTS IN AIR.

R.Glocker.

Z. Phys., Vol. 152, No. 5, 521-37 (1958). In German.

The relationship between the two approaches to radiation dosimetry represented by the röntgen and the rad is examined. In particular the effect is considered of the surrounding medium on the energy received in a thin layer when the thickness of the layer is comparable with the range of the secondary electrons. Conditions under which doses measured in röntgens may be validly converted into rads are laid down. It is shown that while a suggested change in the definition of the röntgen, in which the necessity to take account of all secondary emission is waived, may be attractive for high energy radiations under some circumstances, it does not resolve the practical difficulty of converting röntgens measured in air to rads in tissue; and that even at higher energies there is an alternative approach which is simpler (see following abstract). C.B.Allso

537.531.08

4673. X-RAY DOSIMETRY BY MEANS OF FLUORESCENT FOILS.

R.Glocker and D.Messner.

Z. Phys., Vol. 152, No. 5, 538-45 (1958). In German.

The preparation of plastic foils containing 1% terphenyl is described and their fluorescence spectra as excited by u.v. are recorded. The intensity of fluorescence of 1% terphenyl in Plexiglass, sandwiched between Plexiglass or polyvinyl sheets, in varying thicknesses is applied to X-ray dosimetry. The results are shown to be i accordance with the considerations set out by Glocker (see preceding abstract). C.B.Allsop

537.531.7 : 541.14

4674. THE PHOTOCHEMICAL BEHAVIOUR OF SENSITIZED SILVER BROMIDE AND SILVER CHLORIDE CRYSTALS ON IRRADIATION WITH X-RAYS.

E.Jeltsch.

Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 1-2, 1-12 (1958). In German.

The pure crystals are very insensitive, but sensitization is achieved by the addition of very small quantities (0.01 to 0.04 mole-% of Ag_2S, Ag_2Se, or Ag_2Te (the latter is effective only for AgBr crystals). The crystals acquire a colour at low temperature, the absorption spectrum of which is characteristically dependent on the sensitizer. At room temperature the formation of colloidal silver takes place. W.Good

537.531.85 : 530.145

4675. COMPTON SCATTERING OF X-RAYS FROM NONSPHERICAL CHARGE DISTRIBUTIONS.

A.J.Freeman.

Phys. Rev., Vol. 113, No. 1, 169-75 (Jan. 1, 1959).

The Waller–Hartree theory for the incoherent Compton scattering of X-rays is extended to include the effects of the inherent nonsphericity of atomic charge distributions. The dependence of the scattering on atomic orientation is treated by a general formalism which depends on the use of the matrix elements of a unitary representation of the group of three-dimensional rotations. Application is made to derive the one-electron scattering matrix elements from atoms with s, p, and d electrons. It is shown that by a proper averaging over all orientations of the scattering vector, "mean" scattering formulae result which may be used directly for predicting the scattering from monatomic gases.

537.531.85 : 530.145

4676. COMPTON SCATTERING OF X-RAYS FROM ALUMINUM.

A.J.Freeman.

Phys. Rev., Vol. 113, No. 1, 176-8 (Jan. 1, 1959).

Hartree–Fock self-consistent field wave functions were determined for the aluminium atom and used to calculate the X-ray Compton scattering for aluminium according to the Waller–Hartree theory as extended in a previous paper (see preceding abstract). The predictions of this theory are compared with experiment and previous theoretical calculations. The theoretical results are in very good agreement with the measurements of Walker but differ from those of Laval at low $\sin\theta/\lambda$.

ELECTRON EMISSION . ELECTRON BEAMS

537.533

4677. THE EMISSION PROPERTIES OF THE HEXABORIDES OF CERTAIN RARE-EARTH METALS.

G.A.Kudintseva and B.M.Tsarev.

Radiotekhnika i Elektronika, Vol. 3, No. 3, 428-30 (1958). In Russian.

The results of measurements of the work function ϕ and the emission factor A for the hexaborides of the rare-earth elements Gd, Dy, Ho, Er, Yb and Lu are tabulated. R.C.Glass

537.533 : 537.311.33

4678. ELECTRON EMISSION FROM BREAKDOWN REGIONS IN SiC P–N JUNCTIONS.

L.Patrick and W.J.Choyke.

Phys. Rev. Letters, Vol. 2, No. 2, 48 (Jan. 15, 1959).

Electron emission currents were measured from reverse biased SiC p–n junctions. Maximum emission currents ranged from 10^{-6}-10^{-12} amp and were strongly dependent on the sample preparation. The emission and the number of small luminous sites from which it originated increased rapidly with junction current and the maximum emission current density was estimated to be greater than 1 amp/cm^2. Tests were carried out to verify that the electron current was not caused indirectly by a photoemission mechanism or by thermionic emission. W.G.Townsend

537.533

4679. THE ENERGY DISTRIBUTION OF THE ELECTRON EMISSION FROM MECHANICALLY WORKED METAL SURFACES.

J.Lohff.

Z. Naturforsch., Vol. 12a, No. 3, 267-8 (1957). In German.

The emission from the scratched surface was measured by a retarding field technique, runs being made at different time intervals after the mechanical working. A distribution of the form $N(u) = N_0 \exp[(u - u_k)/\bar{u}]$, where $\bar{u}$ is the mean equivalent energy and u_k is a knee voltage; $e\bar{u} = 0.20 \pm 0.02$ eV for Al. For Li, which gave particularly high emission, electrons with energies as high as 2.4 eV were found. A.H.W.Beck

537.533

4680. THEORETICAL TOTAL-ENERGY DISTRIBUTION OF FIELD-EMITTED ELECTRONS.

R.D.Young.

Phys. Rev., Vol. 113, No. 1, 110-14 (Jan. 1, 1959).

The Fowler–Nordheim equation is derived in terms of total electron energy so as to obtain the total-energy distribution of field-emitted electrons (for experimental data see following abstract). At 0°K the new distribution width is less than $\frac{1}{3}$ of that obtained from the previous "normal-energy" theory. A surprising mirror-image symmetry is observed between the zero-temperature total-energy field emission and the zero-field normal-energy thermionic emission distributions. The total-energy distribution is also derived for the zero-field thermionic case and this is found to be the mirror image of the normal-energy zero-temperature field emission distribution. The new distribution applies to problems involving the total energy of electrons before and after emission.

537.533

4681. EXPERIMENTAL MEASUREMENT OF THE TOTAL-ENERGY DISTRIBUTION OF FIELD-EMITTED ELECTRONS.

R.D.Young and E.W.Müller.

Phys. Rev., Vol. 113, No. 1, 115-20 (Jan. 1, 1959).

Measurements of the energy distribution of field-emitted electrons with an improved retarding-potential analyser revealed an unexpectedly narrow distribution width. Further study indicated that the tube measured the distribution in total energy of field-emitted electrons. Experimental distributions as narrow as 0.14 eV were measured. Data were obtained at liquid hydrogen, liquid nitrogen, and room temperatures and were found to be in good agreement with the new theory. The resolution of the improved analyser is estimated to be between 0.02 and 0.03 eV. The experimental results obtained from the very sensitive total-energy distribution measurements serve as a further verification of the Fowler–Nordheim theory in the total-energy representation (see preceding abstract).

537.533 : 539.27

4682. AUTOELECTRONIC EMISSION OF RHENIUM.

M.I.Elinson, V.A.Gor'kov and G.F.Vasil'ev.

Radiotekhnika i Elektronika, Vol. 3, No. 3, 307-12 (1958). In Russian.

The stability of rhenium under ion bombardment was investigated. The results show it to be five to six times more stable than tungsten. Its weak adsorption capacity for oxygen is also confirmed. Field emission images of rhenium showing its hexagonal structure are illustrated. Rheniated tungsten shows a similar structure. R.C.Glass

537.533

4683. THE ACCURACY OF THE SPHERICAL COLLECTOR METHOD.

N.A.Soboleva.

Radiotekhnika i Elektronika, Vol. 3, No. 3, 339-44 (1958). In Russian.

The errors involved in studying secondary emitters and photocathodes by means of the retarding potential method using a spherical collector are discussed. The error arising from incomplete capture of the current due to non-spherical form of the cathode is investigated by plotting electron trajectories in an electrolytic trough for cubic- and disk-shaped cathodes placed at the centre of a sphere of radius ten times the linear dimensions of the cathode. It is found that the error in these cases can reach 10 to 20%. A considerable reduction of the error is obtained by using a meniscus-shaped cathode of small curvature. R.C.Glass

537.533 : 621.383.27

4684. RECENT WORK ON PHOTOEMISSION AND DARK EMISSION PROBLEMS.

R.W.Engstrom, R.G.Stoudenheimer, H.L.Palmer and D.A.Bly.

I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 120-4 (Dec., 1958).

Recent developments have resulted in multiplier phototubes having wider spectral responses from the ultraviolet to the infrared, having higher absolute sensitivity, and having lower dark emission. The multi-alkali photocathode discovered by Sommer is now being used in the development type multiplier phototube, C7237. Despite the very high red sensitivity of this cathode, the dark emission is a factor 10 lower than that of antimony–cesium cathodes used in typical scintillation counters. Output dark current is basically due to the photocathode dark emission, but this is sometimes increased by regenerative processes. In a special sixteen-stage developmental type with a sealed-in optical shield, the dark current was kept to a minimum for gains as high as 10^9 to 10^{10}. Photocathodes of very high quantum efficiency have been achieved on the 7029 multiplier phototube type of means of an internally evaporated-front-surface photocathode of the antimony–cesium type. Absolute comparisons of special characteristics are presented for the photocathodes mentioned above, as well as for the ultraviolet-sensitive 6903 and for the 7102 multiplier phototube which has red and infrared sensitivity.

537.533

4685. EXCITON-INDUCED PHOTOEMISSION FROM BaO NEAR 80°K.

E.Taft, H.Philipp and L.Apker.

Phys. Rev., Vol. 113, No. 1, 156-8 (Jan. 1, 1959).

Special attention was devoted to the spectral region near $h\nu = 4$ eV, where Zollweg and Jahoda have found four peaks in the optical absorption. When BaO contains electron donor states lying less than 2 eV below the vacuum, these peaks show up clearly at 80°K in the spectral distribution of the photoelectric yield. The effect appears similar in character to exciton-induced photoemission from alkali halides. In BaO, the phenomenon furnishes a particularly sensitive means of studying the weak absorption peak at 3.8 eV, which can give rise to photoemission at photon energies as low as 3.3 eV. This is probably the source of the unexpected slow electrons previously observed by Philipp in energy distributions. Electron donor states giving rise to photoelectric thresholds as small as 0.8 eV were detected.

537.533

4686. THE ENERGY DISTRIBUTION OF PHOTO-ELECTRONS FROM ANTIMONY-CAESIUM CATHODES AT VARIOUS STAGES OF THEIR FORMATION.

G.A.Zheludeva and N.A.Akhmatova.

Radiotekhnika i Elektronika, Vol. 3, No. 3, 400-4 (1958). In Russian.

Retarding potential curves for photo-electrons emitted from an antimony–caesium film at various stages of activation were measured and the work function calculated for each state of the film. It is found that for light quanta of energy less than 4 eV the energy distribution of photo-electrons does not change from one stage to another but for energies greater than 4 eV the electron energy distribution varies substantially on changing from one state of activation to another. It is concluded that in the process of activation a film with the normal antimony–caesium energy structure is not formed immediately but a number of intermediate energy states occur. R.C.Glass

537.533

4687. ON THE TEMPERATURE DEPENDENCE OF THE SPECTRAL PHOTOEMISSION FROM SEMICONDUCTING BISMUTH FILMS.

R.Suhrmann, G.Wedler and E.A.Dierk.

Z. Phys., Vol. 153, No. 1, 96-105 (1958). In German.

Sensitivity was measured for thin films deposited on cold surfaces in high vacua. Fowler plots were used to obtain the work-function. Results were: unordered $\mathrm{Bi}_{(90^\circ\mathrm{K})}$, $\phi = 4.223$ eV; ordered $\mathrm{Bi}_{(293^\circ\mathrm{K})}$, $\phi = 4.228$ eV. At 90°K, the ordered films showed two distinct values of work-function, one for conduction electrons, the other for valence electrons. With 2-3% of Te atoms, metallic conductivity was observed and the emission was of conduction electrons. Here the results were: unordered $\mathrm{BiTe}_{(90^\circ\mathrm{K})}$, 4.316 eV; ordered $\mathrm{BiTe}_{(90^\circ\mathrm{K})}$, 4.802 eV. At 293°K ordered BiTe gave $\phi = 4.849$ eV. A.H.W.Beck

537.533 : 535.37

4688. INVESTIGATIONS OF THE EXO-ELECTRON EMISSION AND LUMINESCENCE OF INORGANIC CRYSTALS.

G.Gourgé.

Z. Phys., Vol. 153, No. 2, 186-206 (1958). In German.

Parallel measurements of luminescence and exo-electron emission were carried out and the measurements extended to low temperatures. The decay of electron emission from NaCl:Ag was examined at various temperatures and influence of change in defect contact (produced thermally, by impurities or by particle bombardment) on the emission measured by "glow curve" techniques. For $CaSO_4$:Mn the relation between exo-electron emission and X-ray dosage is almost linear and the emission might be used in sensitive X-ray dosimetry. G.F.J.Garlick

537.533

4689. SECONDARY EMISSION FROM OXIDE-COATED CATHODES. R.Lenk.
Czech. J. Phys., Vol. 7, No. 3, 293-305 (1957). In Russian.

The effects of the temperature, the primary electrons energy, the degree of activation, and the duration of bombardment on the secondary emission from (BaSr)O, BaO, and SrO were studied. In the investigated temperature range (20° to 600°C), the secondary emission from (BaSr)O increased with rising temperature, that from BaO also increased but to a lesser extent, while the secondary emission from Sr was not affected by temperature variation. On prolonged bombardment both the secondary and the thermionic emission decreased at first, and then reached a steady value. The experimental results are taken to indicate that both the secondary emission and its temperature dependence are affected Ba atoms which, adsorbed on the cathode surface in the form of dipoles or ions, constitute the emission centres. M.H.Sloboda

537.533

4690. ELECTRON EMISSION FROM GRAPHITE CAUSED BY INCIDENCE OF MERCURY IONS. J.Kramář and S.Láska.
Czech. J. Phys., Vol. 8, No. 4, 457-70 (1958).

A brief explanation is given of the process of liberation of electrons from a solid target as a result of incident positive ions, together with a survey of the results of earlier experiments. The principle of the method is explained and a description given of the apparatus used to measure the emission factor of electrons from a graphite target, caused by the incidence of positive mercury ions. The measurements were carried out on electrographite of varying origin and treatment. From the results of these measurements, a number of conclusions are reached on the processes of the liberation of electrons by positive ions, with special reference to mercury rectifiers.

537.533 : 539.1.07 : 621.383.27

4691. DESIGN OF PHOTOMULTIPLIERS FOR THE SUB-MILLIMICROSECOND REGION.
G.A.Morton, R.M.Matheson and M.H.Greenblatt.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 98-104 (Dec., 1958).

The design problem is divided into two parts, one dealing with the photocathode-to-first dynode region, the other with the secondary emission multiplier structure. The two principal causes of poor time resolution in both of these parts are: (1) the different path lengths of electrons originating from separated points on a second; (2) the effect of initial velocities of the emitted electrons on transit times. The electron optical approach to the alleviation of the transit time spread due to path differences is discussed for both the cathode region and the structure. The focusing spiral method of analysing the performance of a structure is of considerable value. The effects of initial velocities can be reduced by ensuring that the electron velocities within the photomultiplier are very high. It is not practical to obtain these high velocities simply by applying a high over-all voltage to the tube because of the loss of secondary emission gain and because of internal and external insulation difficulties. However, the necessary high velocities can be obtained by the use of high voltage field electrodes between successive dynodes, so arranged that electrons are rapidly accelerated to a high velocity and then decelerated before they reach the next dynode. A photomultiplier is described whose design is based upon these two principles. A high-voltage central electrode system between successive dynodes serves to give electrons the high velocity required to minimize transit time spread. Calculated and measured characteristics of this structure are given. When operated in conjunction with suitable circuitry, resolutions of a few micromicroseconds should be obtainable.

537.533 : 621.383.27

4692. FATIGUE IN PHOTOMULTIPLIERS. L.Cathey.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 109-14 (Dec., 1958).

The change of gain with time of two types of dynode used in photomultipliers was studied at several current levels and under repeated fatigue cycles. The fatigue of the photomultiplier takes place predominantly in the last few dynodes. The magnitudes and time dependence of the fatigue vary with dynode current, temperature, construction, and past history.

537.533 : 621.383.27

4693. A HIGH CURRENT COAXIAL PHOTOMULTIPLIER.
N.W.Glass and P.Rudnick.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 124-6 (Dec., 1958).

A photomultiplier structure capable of high current output and relatively fast rise time has been developed. The design incorporates eight separate photocathode elements spaced around the cylindrical structure. A five or six-stage multiplier focuses the electrons on to a central coaxial collector-output structure matched directly to a coaxial line. Each stage of the multiplier consists of a ring of eight dynodes, giving effectively eight parallel current channels from photocathode to collector. The structure is approximately 2.5 in. in diameter by 4.5 in. long. Saturated pulse output currents of 9 A have been obtained in initial tests. Linearity within approximately 10% has been obtained with output currents of 4 A. Calculations and measurements indicate a transit time of approximately 5 mμsec with a spread of the order of 1 mμsec. Current gains of 4000 at 2500 V over all have been obtained with a five-stage multiplier with antimony—cesium dynodes. The geometry of this structure and the operating characteristics are discussed. A pseudo-logarithmic response capability, inherent in this design of tube, is expected to be useful for covering an extended dynamic input range

537.533 : 539.1.07 : 621.383.27

4694. A REVIEW OF 20th CENTURY [ELECTRONICS LTD] PHOTOMULTIPLIERS. A.E.Jennings.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 208-11 (Dec., 1958).

Work at this firm has been directed primarily at production of replacement units for photomultiplier types presently being produced in the United Kingdom. The tube type selected for study was the venetian-blind type. A simplified dynode structure made of a single sheet of metal was developed. Experiments were conducted on the light utilization by a transparent cathode. The collection characteristics of dynodes also were investigated. The results are presented. Some general principles in tube design are outlined.

537.533

4695. A METHOD OF INVESTIGATING SECONDARY ELECTRON EMISSION FROM NON-METALLIC SUBSTANCES.
A.R.Shul'man, I.R.Zakirova, Yu.A.Morozov and S.A.Fridrikhov.
Radiotekhnika i Elektronika, Vol. 3, No. 3, 329-38 (1958).
In Russian.

A pulse method of measuring the fundamental characteristics o secondary emission is described which uses automatic measurement. The method enables direct observation to be made of retarding potential curves and the dependence of secondary coefficient on primary electron energy. A considerable reduction in measuring time, an increase in accuracy and a reduction of errors due to tertiary electrons emitted from the collector are achieved. The reliability of the measurements are discussed and the results of control experiments are described. R.C.Glass

537.533

4696. SECONDARY EMISSION FROM ROUGH SURFACES.
S.F.Rashkovskii.
Radiotekhnika i Elektronika, Vol. 3, No. 3, 371-85 (1958).
In Russian.

Describes an investigation carried out to determine the best surface to use when minimum parasitic secondary emission is desired. As roughness criterion the ratio of average height of protuberance to the spacing between neighbouring protuberances is used. The dependence of secondary emission coefficient on degree of roughness is established. The best results were obtained for tungsten and tantalum surfaces which were oxidized and subsequently reduced. R.C.Glass

537.533 : 621.372.413 : 621.374.4

4697. FREQUENCY MULTIPLICATION IN THE CENTIMETRE WAVE REGION, BY SECONDARY ELECTRONS. K.Krebs.
Z. Phys., Vol. 154, No. 1, 19-26 (1959). In German.

Gives a Fourier analysis of the electron bunches resulting from dynamic secondary emission, as studied by Farnsworth in 1934. According to earlier work of the author (Abstr. 4696/1955 and Abstr 3360/1957) the secondary current wave is composed of a square wave superposed on a cosine wave. This waveform has very large components at high frequencies and is therefore well adapted for use in a frequency multiplier. A.H.W.Beck

537.533 : 621.372.413 : 621.374.4

4698. THE EXCITATION OF CAVITY RESONATORS BY THE PENDULUM MULTIPLICATION OF SECONDARY ELECTRONS.
K.Krebs and H.v.Villiez.
Z. Phys., Vol. 154, No. 1, 27-33 (1959). In German.

See preceding abstract. Describes work on an experimental frequency multiplier. This was driven by a magnetron giving up to 180 W at $\lambda = 21.6$ cm. A coaxial line resonator, tuneable to some of the harmonics, was separated from the fundamental gap by a grid. The second and third harmonics of the drive frequency could be detected in this cavity, but no power figures are given.
A.H.W.Beck

537.533 : 538.566 : 621.372.8

4699. REGARDING G.L.SUCHKIN'S CRITICAL NOTE [ON ELECTRON WAVES IN PERIODIC STRUCTURES]. L.A.Vaĭnshteĭn.

Zh. tekh. Fiz., Vol. 28, No. 10, 2349-52 (1958). In Russian.

In the author's article (Abstr. 7094/1958) use is made of a particular property of monochromatic waves propagated in periodic structures such as certain forms of infinite waveguide. Suchkin (Abstr. 7095/1958) has doubted the validity of the process and here Vaĭnshteĭn shows that the former's doubts are without foundation.
S.C.Dunn

537.533.75 : 538.3

MOTION OF A CHARGED PARTICLE IN A RECTANGULAR WAVEGUIDE FILLED WITH ANISOTROPIC DIELECTRIC.

See Abstr. 3652

537.533 : 537.56

4700. ON PLASMA RESEARCHES WITH AN ELECTRON BEAM PROBE OF SMALL DIAMETER.

M.von Ardenne, S.Schiller and H.Westmeyer.

Exper. Tech. der Phys., Vol. 6, No. 2, 49-62 (1958). In German.

Describes a technique for probing glow discharges etc. with 35-40 kV electron beams. The electron optical system is described and illustrated. A typical discharge chamber is also shown, with a few results and discussion.
J.D.Craggs

537.533 : 539.262 : 545.824

4701. RESOLUTION OF ELECTRON PROBE MICROANALYZERS.

D.B.Wittry.

J. appl. Phys., Vol. 29, No. 11, 1543-8 (Nov., 1958).

In microanalysis using X-ray emission excited on the surface of a thick specimen by an electron probe, the minimum volume element which can be analysed is limited by the size of the electron probe, by fluorescence excitation, and by the penetration and diffusion of the electrons in the specimen. With an electron accelerating voltage of about 30 kV the electrons have an energy of the order of 3 times the critical excitation energy of the K or L X-ray levels of the target and the minimum volume which can be analysed (in the absence of strong fluorescence effects) is of the order of 8 cubic microns for a copper target, and is considerably larger than this for targets of low atomic number or density. It is shown that the resolution in this method of analysis can be improved without loss of statistical accuracy or increase in the time of measurement by (1) improving the quality of the electron optics and by (2) selecting the accelerating voltage and electron probe size. The minimum volume element for practical quantitative analysis can thereby be made as small as about 0.2 cubic microns in a copper target. This is obtained by using slightly larger electron probes and lower accelerating voltages than those representative of current practice.

537.533 : 537.534

4702. AN ELECTROSTATIC ENERGY FILTER. R.Taubert.

Z. Naturforsch., Vol. 12a, No. 2, 169-71 (1957). In German.

A "strong focusing" electrostatic system, of alternately focusing and defocusing fields, is shown to act as an energy-filter for particles of the same mass. Two simple four-pole models are analysed, and stability properties of the Mathieu-type equations involved are used to provide some design data.
B.Meltzer

537.533

4703. ON THE PROBLEM OF MAGNETIC FOCUSING OF BEAMS OF ELECTRONS EMITTED WITH THERMAL VELOCITIES.

J.Vejvodová.

Czech. J. Phys., Vol. 7, No. 2, 191-201 (1957). In Russian.

Electrons emitted with a Maxwellian distribution of thermal velocities from a cathode immersed in a longitudinal uniform magnetic field are drawn towards an anode by means of a longitudinal electrostatic field. The magnetic field focuses the electrons, so that by proper choice of fields and relative dimensions most of them flow through a hole in the anode. Relations between field and flow are derived for point, rectangular, and disk cathodes associated with anode aperture of circular or rectangular shape.
A.E.I.Research Laboratory

537.533 : 621.385.833

4704. NUMERICAL ANALYSIS FOR DESIGN OF ELECTRON GUNS WITH CURVED ELECTRON TRAJECTORIES. I.Sugai.

Proc. Inst. Radio Engrs, Vol. 47, No. 1, 87-8 (Jan., 1959).

Discusses computation of Pierce-type electrodes for a dense electron beam. An I.B.M. 650 digital computer was used; the example studied was a finite section of the flow in a static linear magnetron with magnetic field below cut-off. Possible application to an M-type gun is mentioned.
B.Meltzer

537.533

4705. CALCULATION OF THE ABERRATION COEFFICIENTS OF MAGNETIC ELECTRON LENSES AS FUNCTIONS OF POLE-PIECE GEOMETRY AND OF OPERATING CONDITIONS.

O.Jandeleit and F.Lenz.

Optik, Vol. 16, No. 2, 87-107 (Feb., 1959). In German.

Glaser's third-order aberration coefficients and the three coefficients of chromatic aberration are calculated numerically for different lens strengths of three magnetic electron lenses of given field distributions. Apart from third-order aberration coefficients in the system with an aperture in the back focal plane, the aberration coefficients in the system without aperture are also computed, and integrals for the asymptotic aberration coefficients given. A graphical representation of the dependency of aberration coefficients on lens strength can be made approximately independent of the geometry of pole pieces, i.e. the ratio of gap width s to bore diameter b, by making the aberration coefficients dimension less after multiplication with an appropriate power of Durandeau's unit of length $l = (s + \frac{4}{9}b^2)^{1/2}$, and measuring the lens strength in units of its telescopic value. The telescopic lens strength was numerically determined for these three field distributions. The result supplies additional information about the connection between telescopic lens strength and field form factor.

537.533

4706. COMPARATIVE STUDY OF THE SPHERICAL ABERRATION OF SYMMETRICAL AND ASYMMETRICAL UNIPOTENTIAL ELECTRON LENSES ON THE BASIS OF MEASUREMENTS OF THE TANGENT TO THE EXIT RAY. K.J.Hanssen.

Z. Naturforsch., Vol. 13a, No. 5, 409-14 (May, 1958). In German.

The investigation of the differing properties of symmetrical and asymmetrical electrostatic lenses is now extended from the paraxial (Abstr. 1517/1959) to the marginal rays. Instead of using the normal cardinal elements of a focusing system, the position of which varies rapidly with the height of the incident ray, the lens properties are described in terms of the tangents to the entrant and exit rays. The axial spherical aberration of an asymmetric lens is greater or less than that of the equivalent symmetrical lens, according as the effective centre of the former lies on the object or the image side of the system.
V.E.Cosslett

537.533

4707. THE ELECTROSTATIC FIELD OF AN IMMERSION ELECTRON LENS FORMED BY TWO DIAPHRAGMS. N.N.Lebedev.

Zh. tekh. Fiz., Vol. 27, No. 9, 2097-104 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 1943-50 (Sept., 1957).

This work gives an exact calculation of the field of an electron lens formed of two parallel planes with circular openings of radius a separated by a distance 2b from each other. It is shown that the potential on the lens axis is given by quadratures involving an auxiliary function which is the solution of a one-dimensional integral equation of the second kind with a continuous kernel. An effective method is proposed for solving this integral equation, and the results are presented for several relations between the geometric dimensions. The method developed in the present work can be applied in calculating the fields of more complex lenses made of circular diaphragms.

537.533

4708. A 70 kV ELECTRON MICROSCOPE WITH A COLD-CATHODE AND AN ELECTROSTATIC OBJECTIVE.

M.Gribi, M.Thürkauf, W.Villiger and L.Wegmann.

Optik, Vol. 16, No. 2, 65-86 (Feb., 1959). In German.

An analysis of the requirements to be fulfilled by a versatile operational microscope resulted in the following data: acceleration potential 70 kV, limit of resolution 20-25 A, direct electron-optical magnification 35000 ×. A cold cathode and an electrostatic objective offer a particularly simple solution to this problem. A higher potential was applied to the cold cathode and greater directional beam intensity was obtained. Detailed experiments on voltage breakdown resulted in the development and design of an electrostatic objective which was operationally safe even at 70 kV. The vacuum plant was adapted to the requirements of safe operation and increased contrast; this made the development of a separate oil-diffusion pump and vacuum gauge necessary. Provisions were made also for micro-diffraction and stereoscopic viewing. Simplicity and safety in operation are greatly stressed in the design.

537.533

4709. FORMATION OF THE IMAGE OF A POINT IN A MAGNETIC SPECTROGRAPH USING AN r^{-1} FIELD.
C.Bastard and J.Lafoucrière.
J. Phys. Radium, Vol. 19, No. 7, 674-6 (July, 1958). In French.

A study of the paths of trochoidal type described by charged particles in an inhomogeneous magnetic field of constant rH, with a view to the construction of a high-luminosity β-spectrograph. The study of the twisted paths show that the image of a point is represented by a straight segment perpendicular to the plane of symmetry of the field.

537.533

4710. PRINCIPLE OF A LENS SPECTROMETER WITH ENVELOPE DIAPHRAGMS. H.Daniel.
Z. Naturforsch., Vol. 12a, No. 11, 940-1 (1957). In German.

Use is made of the spherical aberration properties of a thin magnetic lens. Expressions for the electron deflection are given and approximate conditions for the diaphragm positions discussed.
I.C.Demetsopoullos

537.533

4711. THE REFLECTION OF SLOW ELECTRONS FROM THE SURFACES OF METALS AND SEMICONDUCTORS.
D.A.Gorodetskiĭ.
Radiotekhnika i Elektronika, Vol. 3, No. 3, 345-54 (1958). In Russian.

An investigation is made of the reflection of slow electrons from vacuum-deposited layers of gold, silver, barium and germanium on a tungsten base. The results obtained are compared with the results of a theory taking into account both the reflection of the electrons from the surface potential barrier and interaction with the lattice. The reflection of electrons from thin layers of barium and barium oxide on germanium is also investigated and the results compared with data for barium and barium oxide on tungsten. The secondary emission and reflection of electrons for thick layers of barium and barium oxide and the effect of the dissociation of barium oxide on the secondary emission coefficient as a function of primary electron energy is determined.
R.C.Glass

537.533

4712. ON THE MULTIPLE SCATTERING AND BACK-DIFFUSION OF FAST ELECTRONS. H.Frank.
Z. Naturforsch., Vol. 12a, No. 9, 750-1 (1957). In German.

The forward and backward scattering of electrons in the 1-3 MeV range from targets of Pb, Cu, and Al (placed at right angles to the beam and obliquely) is investigated. The depth of complete diffusion and the proportion of back-scattered electrons are determined.
A.E.I. Research Laboratory

537.533

4713. MEASUREMENT OF THE ENERGY- AND Z-DEPENDENCE OF MOTT SCATTERING ASYMMETRY.
H.Bienlein, G.Felsner, K.Güthner, H.v.Issendorff and H.Wegener.
Z. Phys., Vol. 154. No. 3, 376-82 (1959). In German.

With monoenergetic electrons of 120 to 210 keV, the asymmetry of Mott scattering for the elements Au, Ce, Ag and Cu was measured at a constant scattering angle of 120^0. At large energies the calculations of Sherman (Abstr. 457/1957) were confirmed; at small energies the experimental values are smaller because of screening.

537.533

4714. ON FLAMMERSFELD'S RANGE–ENERGY RELATION FOR ELECTRONS [IN ALUMINIUM]. Y.P.Varshni and R.C.Karnatak.
Ann. Phys. (Leipzig). Folge 7, Vol. 2, No. 7-8, 413-20 (1959).

It is found that the relation is satisfactory for $E > 0.2$ MeV. For lower energies, a power relation $E = C R^m$ is suitable. dE/dR as calculated from these equations differs considerably from the theoretical results. Possible reasons for the discrepancy are discussed.

537.533

4715. TEMPERATURE DEPENDENCE OF THE CHARACTERISTIC ENERGY LOSS OF ELECTRONS IN ALUMINUM.
L.B.Leder and L.Marton.
Phys. Rev., Vol. 112, No. 2, 341-3 (Oct. 15, 1958).

The change in the 15 keV characteristic energy loss suffered by 15 keV electrons passing through a thin film of aluminium was measured as a function of temperature from 4.2^0 to 518^0K. It is found that above room temperature the energy loss change agrees, within experimental error, with the change expected due to decreased electron density resulting from expansion of the lattice. However, below room temperature the energy loss change is much greater than expected on the above basis. It was also found that the half-widths of both the energy loss and the zero loss lines increased with decreasing temperature while the ratio of these two remained constant.

537.533 : 539.19 : 539.18

MEASUREMENT OF ATOMIC AND MOLECULAR EXCITATION BY A TRAPPED-ELECTRON METHOD. See Abstr. 3958

537.533

4716. DRIFT VELOCITY OF ELECTRONS IN MERCURY VAPOR AND MERCURY VAPOR–CO_2 MIXTURES. C.W.McCutchen.
Phys. Rev., Vol. 112, No. 6, 1848-51 (Dec. 15, 1958).

The drift velocity of electrons in mercury vapour was measured with an apparatus of the type used by Klema and Allen. The effect of added CO_2 was investigated. The results are used to calculate the electron mean free path in mercury vapour. It is found that mercury vapour has a mean free path maximum (Ramsauer effect) at low electron energy.

ION EMISSION . ION BEAMS

537.534

4717. ON THE HIGH FREQUENCY ION SOURCE.
N.Ryu, Y.Nakajima and I.Nonaka.
Mem. Fac. Sci. Kyusyu Univ. B, Vol. 1, No. 5, 186-91 (Sept., 1955).

An r.f. ion source for use with a Van de Graaf generator is described. The r.f. input is 60 W, with 10 cm^3/hr gas flow. The proton yield is about 70%. Design data and performance curves are given.
T.Mulvey

537.534

4718. He^3 RECIRCULATION AND PURIFICATION SYSTEM FOR A CYCLOTRON ION SOURCE. H.E.Wegner and W.S.Hall.
Rev. sci. Instrum., Vol. 29, No. 12, 1100-3 (Dec., 1958).

This system will recover the gas and purify it continuously. This is accomplished by modifying a mechanical vacuum pump to meet the following special requirements: intake and exhaust sealed for both pressure and vacuum; small volume on the exhaust side; minimum oil volume. This pump, which is used instead of the cyclotron forevacuum pump during He^3 operation, recovers the gas and forces it through a liquid nitrogen-cooled charcoal trap and on to the ion source. The system is completely interlocked to ensure He^3 safety in the event of operator or electrical failure. With a flow rate of 6 cm^3/min, the normal He^3 loss over a period of 200 hr operation was less than 3 cm^3/hr after an initial charge of 1000 cm^3 N.T.P. With trap reactivation periods of 50 hr, no change in ion yield was observed. External beams of approximately 100 μA of doubly charged particles were obtained.

537.534

4719. CANAL-RAY TUBES AS ION SOURCES. R.Döpel.
Abhandl. Dtsch. Akad. Wiss. Berlin Kl. Math. Phys. Tech., 1958, No. 2, 26 pp. In German.

An extensive experimental comparison of the operating characteristics of typical metal and typical glass sources operating up to about 70 kV and 20 mA. The construction of the sources is described and the results given for the following observations: appearance of the discharge and its dependence on voltage V and current I; the characteristic relationships between I, V and pressure p for tubes of various diameters d; the dependence of the ratio of the number of positive ions to neutral atoms in the canal rays on V and canal length l; and the total yield as a function of I, V, d and l. It is concluded that a metal tube should have about twice the diameter of a glass tube to obtain the same yield at the same values of V, I and p but that one type has no advantage over the other.
J.Dutton

537.534

4720. MASS SPECTROMETIC DETERMINATION OF ISOTOPE ABUNDANCE BY THE USE OF AN A.C. METHOD. [Massaspectrometrische bepaling van isotoopverhoudingen onder gebruikmaking van een wisselstroommethode]. P.C.Veenstra.
University of Utrecht Dissertation (1956) ix + 109 pp. In Dutch, with summary (2 pp.) in English.

The thesis is concerned with the construction of a 60^0 magnetic mass spectrometer of 15 cm radius for analysing gas samples. The resolving power is 200 and the mass range up to 250. A special study has been made of the stability of the ion source. A new method of measurement has been evolved. The accelerating voltage is modulated by a square wave so that different isotopes arrive at the same collector in ordered succession (25 c/s) where their relative intensities are compared using an attenuator and phase sensitive detector. The method is said to be superior to the double collector method, especially in connection with servo control.

A.E.I. Research Laboratory

537.534

4721. THE INTERSECTION-ANGLE OF DIRECTION- AND ENERGY-FOCUSING CURVES IN DOUBLE-FOCUSING MASS-SPECTROGRAPHS. H.Liebl.

Optik, Vol. 16, No. 1, 19-26 (Jan., 1959). In German.

Derives formulae for this angle at the point of double-focusing, and gives its values for existing and proposed spectrometers. Discusses the condition for zero angle. B.Meltzer

537.534

4722. VARIATION OF IMAGE ABERRATION COEFFICIENTS AND LINE BROADENING ALONG THE PHOTOGRAPHIC PLATE IN MASS SPECTROGRAPHS HAVING DOUBLE FOCUSING OF THE FIRST ORDER FOR ALL MASSES. L.A.König and H.Hintenberger.

Z. Naturforsch., Vol. 13a, No. 12, 1025-34 (Dec., 1958). In German.

Aberrations and line broadening are worked out for spectrometers of the Mattauch—Herzog type. The results are expressed in diagrammatic form and numerical examples given.

A.E.I. Research Laboratory

537.534 : 539.1.07

4723. MAGNETIC SPECTROMETER FOR 450 MeV PROTONS. A.V.Crewe.

Rev. sci. Instrum., Vol. 29, No. 10, 880-4 (Oct., 1958).

A 60° wedge-focusing magnetic spectrometer has been built for use with the 450 MeV proton beam of the Chicago synchrocyclotron. It has curved pole edges to produce good focusing in one plane only. The minimum line width obtainable is $\sim \frac{1}{4}\%$ with an available solid angle of ~1/2000 sterad. The deflection is vertical, and angular distributions can be measured from 7° to 173° without allowing the primary beam to strike the magnet yoke.

537.534 : 539.1.07

4724. COMBINED MAGNETIC SPECTROGRAPH AND SPECTROMETER. H.A.Enge.

Rev. sci. Instrum., Vol. 29, No. 10, 885-8 (Oct., 1958).

A combination instrument is proposed in which a broad-range magnetic spectrograph can be operated as such or in connection with a magnetic quadrupole lens to form a high-intensity spectrometer. A solid angle of approximately 10^{-2} steradian can be attained with this spectrometer without use of very large magnet gaps.

537.534 : 539.1.07

4725. SECOND-ORDER PROPERTIES OF DOUBLE-FOCUSING SPECTROMETER WITH NONUNIFORM MAGNETIC FIELD. H.Ikegami.

Rev. sci. Instrum., Vol. 29, No. 11, 943-8 (Nov., 1958).

Second-order focusing properties are considered for a nonuniform magnetic field with arbitrary circular boundaries in the case of normal entry and exit. The formula obtained agrees with that obtained by Hintenberger for the special case $\alpha = \beta = 0$. It is also shown that the double and second-order focusing can be achieved simultaneously. The numerical results are represented graphically for a symmetrical double-focusing spectrometer with an arbitrary deflection angle.

537.534 : 539.1.07

4726. MAGNETIC ANALYZER FOR NUCLEAR REACTION PRODUCTS.

O.Meier, Jr, N.R.Fletcher, W.R.Wisseman and R.M.Williamson.

Rev. sci. Instrum., Vol. 29, No. 11, 1004-8 (Nov., 1958).

A magnetic analyser for nuclear reaction products has been built which employs a sector-shaped uniform magnetic field. The shaped sectors are inserted in the 8.5 in. gap of a C-shaped magnet with a 12 × 12 in. cross-section. The iron core is 54 × 33 in., and 69 360 ampere-turns give 13 500 gauss across a total air gap of $1\frac{5}{8}$ in. In the notation of Cross (see Abstr. 320/1952), the parameters were: $\rho = 15$ in., $\phi = 60^\circ$, useful gap = 1.5 in., $l' = 22.5$ in., $l'' = 45$ in., $\epsilon_1 = +46^\circ 38'$, $\epsilon_2 = -18^\circ 21'$, max. usable $\alpha = \pm 3^\circ$, max. usable $\omega = \pm 1.6^\circ$. The entrance boundary was straight, and the exit boundary had a convex curvature of 123.7 in. The boundaries of the sector and the locations of the object and image positions were corrected for the effect of the fringing field. The observed l'' was 46.5 in. Fringing field focusing in the direction perpendicular to the plane of deflection was not as strong as calculated; the maximum image height was 2 in. The magnet is capable of bending 12 MeV protons and has an energy resolution of 300 for the maximum useful solid angle of 1/2000 of 4π steradians. The observed maximum energy resolution was 400. The advantages of this magnet are simplicity of construction and ease of adaptation to other sector parameters. The core is also an adaptable laboratory magnet.

537.534 : 535.822.3

MEASUREMENT OF THE SEPARATION OF MASS SPECTROGRAPH DOUBLETS BY USE OF A PHOTOELECTRIC MICROSCOPE.

See Abstr. 4502

537.534

4727. THE INFLUENCE ON SOLID SURFACES OF AN IONIZED GAS ATMOSPHERE. I. THE REACTION BETWEEN TUNGSTEN AND CARBON. H.Schmellenmeier.

Exper. Tech. der Phys., Vol. 1, No. 2, 49-68 (Sept., 1953). In German.

Describes an experimental procedure for the production of tungsten carbide layers on steel surfaces; the surfaces are first coated with a tungsten—cobalt alloy by electrolysis and then used as the cathode in a glow discharge (current density $\sim$ mA/cm^2) in acetylene. The tungsten carbide layers, so formed are shown to be nearly as hard as "Widia" metal and to be about 4μ in depth.

J.Dutton

537.534

4728. ION INDUCED REEMISSION OF NOBLE GASES FROM A NICKEL SURFACE. J.H.Carmichael and E.A.Trendelenburg.

J. appl. Phys., Vol. 29, No. 11, 1570-7 (Nov., 1958).

Each of the noble gases, He, Ne, A, and Kr, was ionically pumped with an energy of about 100 eV into a nickel target and was subsequently released by a similar bombardment using a different noble gas. A mass spectrometer permitted the measurement of both the reemission of the trapped atoms and the trapping of the bombarding particles. The reemission mechanism is described in terms of a simple model which assumes that the trapped atoms are released by the bombarding particles through a mechanism of sputtering of either the target material or the trapped gas or a combination of both. The experimental results are in agreement with the model. A direct replacement of a trapped atom from its trapping site by a bombarding particle is shown to be a relatively unimportant factor in the reemission process. Measurements of the reemission rates of the trapped atoms have yielded information concerning the depth distribution of the trapped atoms in the nickel target. In particular, saturation of the depth distribution has been observed for Ne, A, and Kr at concentrations below one equivalent monolayer while He showed no such effects at the highest concentrations used, which corresponded to approximately 15 equivalent monolayers.

537.534 : 539.231

SPUTTERING OF A POLYCRYSTALLINE SILVER SURFACE BOMBARDED WITH MONOENERGETIC ARGON IONS OF LOW ENERGY (40-240 eV).

See Abstr. 4060

PARTICLE ACCELERATORS

537.54

4729. ON THE MAXIMAL ENERGY AND INTENSITY OF THE ELECTRONS ACCELERATED BY THE MICROTRON. F.Porreca.

Nuovo Cimento, Vol. 11, No. 2, 283-6 (Jan. 16, 1959).

Taking in account the electron's acceleration time in a microtron operating with a = 2 and b = 1 and the pulse duration of the magnetron, the maximal values of the energy and the intensity of the accelerated beam are established.

537.54

4730. THE PRESENT STATE OF THE 1000 MeV NATIONAL ELECTRON SYNCHROTRON [ROME]. G.Salvini.

Nuovo Cimento Suppl., Vol. 9, No. 2, 402-15 (1958). In Italian.

An interim report on the 1000 MeV electron synchrotron in Rome is presented from the point of view of work completed, and projected experiments. All magnet segments have been tested and are in the process of alignment, the condenser banks have been permanently sited and work is in hand on the installation of the controls. The correction and defining coils have been subjected to exhaustive tests and currently the focusing problems are being studied. The injector system and radiofrequency power-supplies are discussed in comparison with existing machines. A preliminary study of beam extraction is being made. On the experimental side, beam-measuring devices are under construction, two beam-deflecting magnets are nearing completion and counting circuitry is being prepared. S.J.St-Lorant

537.54

4731. MULTIPLE ELECTRON CAPTURE IN THE BETATRON REGIME. V.P.Yashukov.
Zh. tekh. Fiz., Vol. 28, No. 6, 1363-4 (1958). In Russian.

An experimental study of the effects of injecting electrons twice during each accelerating cycle. The results suggest that multiple injection may increase considerably the γ-ray intensities from electron accelerators. W.O.Lock

537.54 : 621.384.612 : 621.372.413

4732. SELF-EXCITED 150 KILOVOLT RESONANT CAVITY FOR OPERATION AT 87 MEGACYCLES.
H.E.Jackson, R.L.Martin and J.Waggoner.
Rev. sci. Instrum., Vol. 30, No. 3, 187-90 (March, 1959).

A high-voltage, fixed frequency re-entrant cavity of moderate power requirements designed for use in the Cornell 1.5-BeV synchrotron is described. Design considerations and details of the cavity gap structure are presented. The problem of multipactoring is described. Advantages of coaxial gap construction using an internal insulator are given. In particular a d.c. bias to prevent multipactoring can easily be applied. A simplified analysis of the operation of the cavity in terms of equivalent circuits is also given.

537.54 : 538.565 : 621.372.413

COUPLING OF RESONANT CAVITIES BY RESONANT COUPLING DEVICES. See Abstr. 3665

537.54 : 538.565 : 621.372.413

PERTURBATION OF A RESONATOR. See Abstr. 3666

IONIZATION . PLASMA

537.56

4733. LONG-RANGE INTERACTIONS IN IONIZED GASES IN THERMAL EQUILIBRIUM. F.D.Kahn.
Astrophys. J., Vol. 129, No. 1, 205-16 (Jan., 1959).

Collective long-range interactions affect the distribution of the charged particles belonging to a plasma in thermal equilibrium. The charge density can be expressed in terms of spatial Fourier components; when this is done, it is found that at a finite temperature the components of low wave-number k have an amplitude proportional to k^2, while in a random distribution the amplitude is independent of k. The components of large wave-number remain unaffected, the critical wave-number being of the order $(4\pi\Sigma\epsilon^2 N/\kappa T)^{1/2}$, where the summation extends over all particles in a typical unit volume. The partial ordering thus introduced may be important when the charged particles act together coherently. Thus, for example, it brings about a reduction in the scattering cross-section, per electron, for electromagnetic radiation.

537.56

4734. PLASMA DYNAMICAL DETERMINATION OF SHOCK THICKNESS IN AN IONIZED GAS. E.N.Parker.
Astrophys. J., Vol. 129, No. 1, 217-23 (Jan., 1959).

It is shown that the principal interaction in a shock front in a tenuous ionized gas is a plasma interaction in which the ions transfer their translational energy to the plasma oscillations. The effect is, of course, of interest in auroral theories and in solar radio noise. It turns out to be the dominant effect in determining shock thicknesses nearly everywhere that the gas density is less than the solar photospheric value of 10^{16} atoms/cm^3. It is estimated that shock thicknesses in interstellar H II regions and in interplanetary space will be 1 km or less, even though the mean free paths may be 10^6 km or more and the ion Larmor radius ~ 100 km.

537.56

4735. MEASUREMENT OF ELECTRON CONCENTRATION OF PLASMA IN TOROIDAL RESONATOR. M.Šícha and V.Veselý.
Czech. J. Phys., Vol. 8, No. 2, 256-7 (1958). In Russian.

537.56 : 621.039 : 621.387

4736. RAPID COMPRESSION OF A PLASMA WITH AZIMUTHAL CURRENTS. G.B.F.Niblett.
Proc. Instn Elect. Engrs, Paper 2882 [Convention on Thermonuclear Processes], publ. April, 1959, 6 pp. To be republished in Vol. 106A (1959).

Discusses a rapid pinch process in which azimuthal currents and their associated axial magnetic fields are used to heat and confine a plasma. A simple one-dimensional model of the fast pinch process is used to show how the temperature attained by the plasma depends upon the discharge parameters and in particular that the energy per particle is proportional to the electric field developed across the plasma surface. Previous work on this form of pinch effect is reviewed and an account is given of preliminary experiments at the Atomic Weapons Research Establishment (A.W.R.E.). The principal features of a toroidal system using azimuthal currents and axial fields to heat and subsequently confine a plasma is presented and the advantages and consequences of this configuration are examined, particularly as compared with a torus using axial currents. After the initial rapid heating process the plasma and magnetic field diffus into each other and the configuration is similar to that in the Stellarator, with similar stability problems and similar possibilities of continuous operation.

537.56 : 621.387

4737. THE CIRCUIT DYNAMICS OF PLASMA. B.S.Liley.
Proc. Instn Elect. Engrs, Paper 2899 [Convention on Thermonuclear Processes], publ. April, 1959, 8 pp. To be republished in Vol. 106A (1959).

Equations applicable to the behaviour of plasma in bulk are derived and discussed. Starting with the equations of plasma dynamics the total and thermal energy equations are integrated over all space. Certain bulk variables such as the geometrical dimensions of a conductor and the total charge in a circuit are then introduced. Subsequent definition of various circuit parameters and the introduction of generalized e.m.f.'s permit the integrated equations to be expressed in terms of the bulk variables. Using the fact that the total energy is constant, it is possible to obtain the equations of circuit dynamics, applicable to a plasma, in Lagrangian form. The derivation is not rigorous, relying for its validity on physical arguments and the consistency of the final equations with those of plasma dynamics. Again, the proof is confined to cases in which the nature of the functions determining the distribution of mass, current and charge density throughout the volume of a conductor are time-independent. The generalized e.m.f. concept is unfamiliar; it mainly arises from coupling between the electrical and thermal properties of a plasma. It is shown that these e.m.f.'s lead to a form of magneto-resistive coupling and, even in the absence of Hall currents, an apparent anisotropic resistivity. A general proof of the equivalent transformer circuit is given.

537.56

4738. CORRELATIONS IN A PLASMA IN EQUILIBRIUM. J.Yvon.
J. Phys. Radium, Vol. 19, No. 10, 733-8 (Oct., 1958). In French.

A fully ionized plasma in thermodynamic equilibrium is considered. An attempt is made at reviewing the calculation of spatial correlations in such a plasma. The equations of recurrence and the principle of superposition are used. The linear approximation is treated first. The next higher approximation is studied in the case of a neutral homogeneous and isotropic plasma.

537.56

4739. SUPRATHERMAL PARTICLES. III. ELECTRONS.
E.N.Parker.
Phys. Rev., Vol. 112, No. 5, 1429-35 (Dec. 1, 1958).

For Pt II, see Abstr. 1551 (1959). Certain phenomena in nature, such as 50 to 100 keV electrons of the aurora, suggest that there are plasma-dynamical processes which can quickly transfer the translational energy of the ions in a plasma stream to the electrons (some 20 keV/ion for a 2000-km/sec solar wind). It is shown that two interpenetrating streams of noncolliding and initially neutral plasma can achieve this energy transfer with a characteristic time comparable to $(M/m)^{1/2}$ times the plasma period. The process is closely analogous to the excitation of plasma oscillations by two interpenetrating electron streams, but of course proceeds to much greater electron energies because the ion components of the streams carry so much more kinetic energy than do the electron components. Hence, besides the auroral electrons, it is probably responsible for solar radio emission, rather than the electron streams implied in current theories. Further, the process is probably the dominant interaction in shock fronts, particularly in astrophysical cases where neither direct collisions nor the existing weak magnetic fields can give sharp fronts. The characteristic thickness of a shock front in the solar wind is of the order of 10^4 cm due to the above plasma excitation whereas the Larmor radius of the ions, which would otherwise determine the shock thickness in the absence of collisions, is 100 km or more.

537.56 : 538.566.2

4740. CONDUCTIVITY OF PLASMAS TO MICROWAVES.
P.H.Fang.
Phys. Rev., Vol. 113, No. 1, 13-14 (Jan. 1, 1959).

Plasma conductivities for electrons with a Maxwellian energy distribution are evaluated for the cases in which the collision cross-section is (i) velocity independent and (ii) inversely proportional to the velocity. The corresponding distribution functions of relaxation times are discussed.

537.56

4741. NONLINEAR ELECTRON OSCILLATIONS IN A COLD PLASMA. J.M.Dawson.
Phys. Rev., Vol. 113, No. 2, 383-7 (Jan. 15, 1959).

Investigations of nonlinear electron oscillations in a cold plasma where the thermal motions may be neglected indicate that except for the simplest one-dimensional situation such oscillations will destroy themselves through the development of multistream flow. It is found possible to give an exact analysis of oscillations with plane, cylindrical, and spherical symmetry. Plane oscillations in a uniform plasma are found to be stable below a critical amplitude. For larger amplitudes it is found that multistream flow or fine-scale mixing sets in on the first oscillation. Oscillations with spherical or cylindrical symmetry develop multistream flow almost always, independent of the amplitude. The time required for mixing to start is inversely proportional to the square of the amplitude. Plane oscillations in a nonuniform plasma are also found to exhibit this type of behaviour. Some considerations are also given to more general oscillations and a calculation is presented which indicates that multistream flow will usually set in.

537.56

4742. TRAJECTORY-WISE ANALYSIS OF CYLINDRICAL AND PLANE PLASMAS IN A MAGNETIC FIELD AND WITHOUT COLLISIONS. L.Tonks.
Phys. Rev., Vol. 113, No. 2, 400-7 (Jan. 15, 1959).

The anatomy of the transition region between vacuum and a fully developed magnetically immobilized ionized-gas plasma has been examined by following particle trajectories in detail. The mathematical formulation required machine computation for its full interpretation. This approach recognizes the structure imparted to the plasma by the radius of gyration and thus serves as a critique of the magnetohydrodynamic method. It furnishes the microscopic verification of that macroscopic approach and supplements it by showing that the sharpness of transitions in a plasma are limited, in effect, by the gyration radius in the stronger, not the weaker, magnetic field. Especially, it brings out the greater importance of the tensor character of the plasma pressure in the cylindrical case where the combined kinetic and magnetic energy density in uniform interior regions of the plasma is not equal to the magnetic energy density in the vacuum. The analysis also exhibits the intense mass motion at the surface of a strong plasma constituting a paramagnetic electric current and probably having dynamical effects. The numerical work is correlated where possible with direct theoretical results.

537.56

4743. EXPERIMENTS ON THE OHMIC HEATING AND CONFINEMENT OF PLASMA IN A STELLARATOR.
T.Coor, S.P.Cunningham, R.A.Ellis, M.A.Heald and A.Z.Kranz.
Phys. of Fluids, Vol. 1, No. 5, 411-20 (Sept.-Oct., 1958).

The basic concepts of confinement and ohmic heating in a figure-eight stellarator are briefly reviewed and relevant experimental data summarized. The production of energetic X-rays by runaway electrons, up to 10 msec after the disappearance of the accelerating field, has indicated effective single-particle confinement by the magnetic fields of 20 000 to 30 000 G. However, the plasma confinement time during ohmic heating appears to be limited by unknown processes to approximately 100 μsec for hydrogen, more than three orders of magnitude shorter than predicted from classical collisional diffusion. The ionization level in a helium discharge, with an initial pressure of about 1 μ of Hg, becomes virtually complete during the heating pulse, and the electric resistivity corresponds to a kinetic temperature of about 100 V, or 10^5 deg. After the heating pulse, the electron density decays with a time constant as great as 6 msec under some conditions. The hydromagnetic kink instability predicted by Kruskal has been clearly observed.

537.56

4744. INVERSE PINCH EFFECT. O.A Anderson, H.P.Furth, J.M.Stone and R.E.Wright.
Phys. of Fluids, Vol. 1, No. 6, 489-94 (Nov.-Dec., 1958).

In the conventional pinch effect an ionized gas is enclosed by a conducting cylinder, and a sufficiently large current passing through the gas and returning along the inner wall of the cylinder produces a magnetic field which compresses the gas into an axial filament. A device is described which produces an inverse pinch effect. Here the above conducting cylinder is replaced by an axial rod surrounded by the ionized gas. When a current passes through the gas and returns along the rod the magnetic field pushes the plasma outward, leaving a cylindrical vacuum region behind. The velocity and thickness of the expanding plasma front have been studied optically and by means of magnetic probes. Except at the highest gas densities, the velocity is in good agreement with the "snow plow" theory of Rosenbluth, and the thickness of the front is reasonably consistant with the "snow plow" model. At the higher densities it appears that diffusion of magnetic field into the plasma is significant. The advantages of the inverse pinch effect in studying plasma behavior and the idea of a magnetically stabilized inverse pinch are discussed.

537.56

4745. IGNITION OF A THERMONUCLEAR PLASMA BY HIGH-ENERGY INJECTION. A.Simon.
Phys. of Fluids, Vol. 1, No. 6, 495-500 (Nov.-Dec., 1958).

The effect of the neutral gas background on the formation of a thermonuclear plasma by high-energy injection is discussed. Three ways of overcoming this barrier are detailed. The first is by sufficiently reducing the initial gas pressure; the second by injecting sufficient current so that plasma self-shielding or "burnout" occurs; and the third by use of the ion pumping or "gettering" action of the trapped plasma. Numerical-examples are given. In particular the requirements for "burnout" do not seem excessively difficult to attain.

537.56

4746. UNSTABLE PLASMA OSCILLATIONS IN A MAGNETIC FIELD. E.G.Harris.
Phys. Rev. Letters, Vol. 2, No. 2, 34-6 (Jan. 15, 1959).

Examines theoretically small amplitude oscillations and instabilities of a fully ionized quasi-neutral plasma in a constant uniform externally produced magnetic field set up by anisotropy of the particle velocity distributions. C.G.Morgan

537.56

4747. EXCITATION OF OSCILLATIONS IN A PLASMA LAYER. M.Sumi.
Phys. Rev. Letters, Vol. 2, No. 2, 37-9 (Jan. 15, 1959).

An extension of the author's earlier theory [M.Sumi, J. Phys. Soc. Japan (to be published)] is applied to the possible occurrence of standing waves in a uniform plasma layer. The theory is compared with experimental results of Looney and Brown (Abstr. 4739/1954) and Bailey and Emeleus (Abstr. 6033/1956).

C.G.Morgan

537.56 : 539.17

4748. NEUTRON EMISSION OF HIGH CURRENT DEUTERIUM DISCHARGES.
E.Fünfer, H.Herold, G.Lehner, H.Tuczek and C.Andelfinger.
Z. Naturforsch., Vol. 13a, No. 7, 524-31 (July, 1958). In German.

A 40 μF condenser bank was discharged through a column of pure deuterium. Currents of about 100 kA were obtained. The compression of the plasma was detected by current and voltage measurements and observed by a Kerr-cell camera. Neutrons were emitted by the plasma; their total number/discharge was measured by silver activation and their distribution by a fast scintillation counter. The X and γ-rays emitted were also investigated. It was found that the plasma was contracting with velocities up to 10^7 cm/sec and emitting about 10^7 neutrons in pulses 2.5×10^{-6} sec in duration. On the basis of the results obtained, it was concluded that the plasma was in at least partial thermal equilibrium and attained temperatures of about 10^6 °K. D.H.Lord

537.56

4749. ON THE RECIPROCAL ACTION ENERGY OF CHARGE CARRIERS IN A PLASMA. O.Theimer.
Z. Naturforsch., Vol. 13a, No. 7, 568-9 (July, 1958). In German.

A very brief discussion of certain aspects of the Debye—Hückel theory of electrolytes, as applied to plasmas. For example the Debye shielding distance is introduced. J.D.Craggs

537.56

4750. ON THE EFFECT OF COULOMB CORRELATIONS ON THE OSCILLATION SPECTRUM OF AN ELECTRON PLASMA.
P.S.Zȳryanov.
Zh. eksper. teor. Fiz., Vol. 34, No. 1, 232-3 (1958). In Russian.

The effect is calculated by using the methods previously developed by the author (Abstr. 1537/1958). P.Roman

537.56 : 539.17

NEW INVESTIGATIONS WITH SCEPTRE III. See Abstr. 3950

537.56 : 537.533

ON PLASMA RESEARCHES WITH AN ELECTRON BEAM PROBE OF SMALL DIAMETER. See Abstr. 4700

537.562 : 538.3 : 532.5

4751. HYDROMAGNETIC EQUATIONS FOR TWO ISOTOPES IN A COMPLETELY IONIZED GAS. J.Slepian.

Phys. Rev., Vol. 112, No. 5, 1441-4 (Dec. 1, 1958).

The hydromagnetic equation for a completely ionized gas of high density with a single isotope is given, and from it the two hydromagnetic equations with two isotopes are derived. The difference between the accelerations of the isotopes at any internal point is then equal to $\delta M/M$ times $(1/\rho)[j \times B]$, the force on the induced current per unit density due to the magnetic field. It is then shown that the ionic centrifuge gives almost no enrichment of the isotopes deposited, whereas the magneto-ionic expander gives a very high enrichment.

537.564

4752. TOTAL CROSS SECTIONS FOR MULTIPLE ELECTRON STRIPPING IN ATOMIC COLLISIONS AT ENERGIES TO 100 keV.

P.R.Jones, F.P.Ziemba, H.A.Moses and E.Everhart.

Phys. Rev., Vol. 113, No. 1, 182-91 (Jan. 1, 1959).

Total cross-sections were measured for electron capture and stripping of He^+, Ne^+, and A^+ ions in single collisions of He^+ on He, Ne, and A; Ne^+ on Ne and A; and A^+ on A. Where He^+ ions are incident the cross-sections are given for electron capture, σ_{10}; for electron loss, σ_{12}; and for "elastic" scattering in excess of one degree, $\sigma_{11} > 1^\circ$. Where Ne^+ and A^+ are incident the cross-sections for multiple stripping $\sigma_{13}, \cdots, \sigma_{17}$ are given also. The measurements were made at 25, 50, and 100 keV and at additional energies in two cases where a maximum in the electron capture cross-section was observed. Each total cross-section was compiled by adding the contributions from the various angular regions into which the incident particle may be scattered. The contribution from the particles scattered between 0° and 1° was measured directly, while that for regions in excess of 1° was obtained by integrating the measured differential cross-sections. In the region between 1° and 4° the differential cross-section for each process was measured with high resolution and these data are presented here separately. These differential measurements supplement data previously published for angles in excess of 4° (see Abstr. 5986/1956; 8687/1957). Tables are presented showing the contribution of each of the angular regions to the various total cross-sections. Large-angle scattering is found to make a significant contribution to the total cross-sections for the production of the more highly ionized particles.

537.564

4753. IONIZATION LOSS BY μ MESONS IN HELIUM.

R.E.Lanou, Jr and H.L.Kraybill.

Phys. Rev., Vol. 113, No. 2, 657-61 (Jan. 15, 1959).

The ionization loss by cosmic-ray μ mesons in helium gas was measured as a function of momentum. The ionization loss was determined with proportional counters and the momenta were measured by a magnetic spectrometer which resolved particles in the momentum region from 3.3 BeV/c to 140 BeV/c. It was found that helium gas at 2.7 atm pressure exhibits a density-effect saturation of the most probable ionization loss and that this saturation is complete at a $p/\mu c$ value of about 200. Under the conditions of normalization used in this experiment, the value of the ionization loss at which the Fermi plateau occurs is 1.28 ± 0.04 times the value at the minimum. This is in agreement with calculations based on the Sternheimer theory for the particular counter filling used in this experiment.

537.564

4754. RELATIVE BETA-RAY ENERGY LOSS PER ION PAIR PRODUCED IN WATER VAPOR AND IN AIR.

C.Wingate, W.Gross and G.Failla.

Radiation Research, Vol. 8, No. 5, 411-16 (May, 1958).

The ratio of the average energy loss per ion-pair produced in water vapour to that in air is deduced from measurements in the vapour and in nitrogen and a previous comparison of nitrogen relative to air (Gross,W. and Kunz,W., Radiation Research, Vol. 5, 480, 1956).

C.G.Morgan

538.566 : 537.533 : 621.372.8

ELECTRON WAVES IN PERIODIC STRUCTURES. See Abstr. 4699

538.566.2 : 537.56

CONDUCTIVITY OF PLASMAS TO MICROWAVES. See Abstr. 4740

537.568 : 523.75

4755. ON THE POSSIBLE FORMATION OF H^- BY WAY OF H_2^-.

I.Fischer-Hjalmars.

Ark. Fys., Vol. 13, Paper 36, 481-2 (1958).

According to Ohman (Abstr. 34/1957) certain high-altitude dar coronal markings can be explained as absorption structures involvi the recombination of H_2 by a process of inverse pre-dissociation. It is here proposed that the pre-dissociation can occur through the following reaction:

$$H(^2S) + H(^2P) \rightarrow H_2(f^3\Sigma_u^+) \xrightarrow[\text{conversion}]{\text{internal}} H_2(d^3\Pi_u)$$

which should have a reasonable probability in the solar corona where the populations of the excited states of H are comparatively large. The more probable subsequent reactions leading to the formation of stable $H^-(^1s)$ ions are:

$$H_2(d^3\Pi_u) \xrightarrow{\text{radiation}} H_2(a^3\Sigma_g^+) + e \begin{array}{l} \nearrow H_2^-(^2\Sigma_g^+) \rightarrow H(^2S) + H^-(^1S) \\ \searrow H_2^-(^2\Sigma_u^+) \rightarrow H(^2S) + H^-(^1S). \end{array}$$

The existence of H_2^- has never been proved experimentally.

D.R.Barber

537.568

4756. DISSOCIATION OF FORMIC ACID AND DEUTEROFORMIC ACIDS BY ION—MOLECULE COLLISION. C.E.Melton and G.A.Rop

J. chem. Phys., Vol. 29, No. 2, 400-5 (Aug., 1958).

The dissociation of 5.1 keV $HCOOH^+$, $DCOOH^+$, and $HCOOD^+$ ions by ion-molecule collision with H_2, D_2, He, N_2, A, and Kr was investigated in a mass spectrometer. Approximate values for the cross-sections for the resultant fragment ions were calculated. Positive ion fragments CHO^+ and CHO_2^+ are produced by loss of hydrogen from both of the possible positions. However, rupture of the C—H bond is a factor of two more probable than cleavage of the O—H bond in the formation of CHO_2^+. The CHO^+ ion fragment is formed mainly by removal of the hydroxyl group.

537.568

4757. MEASUREMENTS OF DISSOCIATIVE RECOMBINATION AND DIFFUSION IN NITROGEN AT LOW PRESSURES.

A.C.Faire and K.S.W.Champion.

Phys. Rev., Vol. 113, No. 1, 1-6 (Jan. 1, 1959).

The measurements of recombination in nitrogen and nitrogen-helium mixtures by Faire, Fundingsland, Aden, and Champion (see Abstr. 8848/1958) were extended using, in addition to the basic microwave techniques, a monochromator and photomultiplier to study the spectra emitted. Electron production in the afterglow due to helium metastable atoms was investigated and the results have made it possible to correct, where necessary, the apparent value of the recombination coefficient of nitrogen ions in nitrogen-helium mixtures. In addition, the ambipolar diffusion coefficient in nitrogen was determined. This has been used to correct for losses due to fundamental mode diffusion. The magnitude of higher mode diffusion is discussed and shown to be small in this experiment. The average values of the recombination and diffusion coefficients determined by this experiment are, respectively, $\alpha = (4.0 \pm 0.3) \times 10^{-7}$ cm^2 sec^{-1}, $D_ap = 220 \pm 30$ cm^2 sec^{-1} mm Hg, with an electron temperature of approximately 400°K. For pressures below 4 mm Hg it was found that the value of α was independent of pressure.

537.572 : 535.376

4758. THE DIFFERENTIAL EXCITATION POWER OF α-PARTICLES IN LUMINESCENT PLASTIC FOILS.

F.W.Geck and W.Hanle.

Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 142-3 (1957). In German.

Differential ionization, by α-particles, frequently measured in gases, has for the first time been measured in a solid, polystyrene foil containing diethyl hydroquinonecarboxylate, which in polystyrene has a strong luminescence maximum at 4575 A. The maximum of excitation by α-particles was found with those having an energy of 4 MeV.

R.C.Murray

537.572

4759. IONS OF Eu IN THE OXIDES AND SULPHIDES OF ALKALINE EARTHS. P.Brauer.

Z. Naturforsch., Vol. 12a, No. 3, 233-40 (1957). In German.

Corroborates the author's previous finding (see Abstr. 873/1952) that the work done in the ionization of Eu^{2+} inserted in all alkaline earth oxides is smaller than in the case of Eu^{2+} inserted in all alkaline earth sulphides. The polarization and distortion of the host crystal were taken in consideration. The value obtained for the energy of ionization of Eu^{2+} agrees with that obtained previously.

F.Lachman

COSMIC RAYS

537.591.1

4760. GAMMA RAYS OF LOW ENERGY IN THE COSMIC RADIATION AT SEA LEVEL.

N.D'Angelo.

Amer. J. Phys., Vol. 27, No. 3, 147-50 (March, 1959).

A study of the cosmic gamma rays of low energy at sea level by means of a NaI crystal spectrometer is described. No gamma-ray lines of direct atmospheric origin are found in the energy region investigated.

537.591

4761. THE DURATION OF THE EMISSION AND THE GRADIENT OF THE IMPULSE SPECTRUM OF THE SOLAR COSMIC RAYS DURING THE CHROMOSPHERIC ERUPTION OF 23/2/1956.

G.Pfotzer.

Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 26-41 (1957). In German.

Recorded data on neutrons have been used to determine the direct radiation to earth, and the retarded radiation stored during up to 16 hours in the solar system. Taking a spectrum $f(p)dp \sim p^{-\gamma}$, the exponent $\gamma \cong 3.4$ can be taken for the impulse range $2 \leq p \leq 6$ GeV/c. For the stored radiation $5.5 \leq \gamma \leq 7$ according to Meyer (Abstr. 2387/1957), showing the loss in radiation in the storage process.

C.Turner

537.591.15

4762. AN INTERACTION OF NUCLEONS AT AN ENERGY BETWEEN 10^{14} AND 10^{15} eV/NUCLEON.

J.Pernegr, V.Petržílka and J.Vrána.

Czech. J. Phys., Vol. 8, No. 2, 137-47 (1958).

A jet (0 + 14) α with primary energy $\{3.3^{+5.3}_{-2.2}\} \times 10^{14}$ eV/nucleon was observed in the "I"-stack. An interaction with very small multiplicity (n_s = 3 or 4) found in the axis of the jet is probably caused by another nucleon from the α-primary. Ten particles of the narrow cone have opening angles of some 10^{-4} radians; four particles in the diffuse cone are emitted at angles of a few 10^{-2} radians. A pronounced anisotropy exists in the c.m. system. The coefficient of inelasticity ≈ 0.1 was calculated directly extrapolating the measured energies of secondaries. The interpretation of the whole event is in good agreement with Heisenberg's theory of multiple production of particles.

537.591.15

4763. FURTHER EVIDENCE FOR A VARIATION IN THE RATE OF DENSE EXTENSIVE AIR SHOWERS WITH SOLAR TIME.

C.B.A.McCusker, D.E.Page and R.A.Reid.

Phys. Rev., Vol. 113, No. 2, 712-13 (Jan. 15, 1959).

The variation in the rate of dense extensive air showers with solar time previously found in Dublin, Ireland was confirmed using a similar apparatus situated in Mona, Jamaica. It is suggested that this and other variations in rate with solar time may possibly be due to a periodic change in the structure function of the showers.

537.591.15

4764. ON THE CLOSE PAIR EFFECT IN COSMIC RAY STARS.

S.Salim, Abd El-Fattah El-Nadi and G.Ortner.

Proc. Math. Phys. Soc. Egypt, No. 21, 113-17 (May, 1957).

Photographic plates exposed at mountain altitudes (3650 and 2300 m) were examined for the close pair effect and two tests were applied which showed that the distribution of cosmic ray stars conform to a random distribution for distances ≤ 1 mm.

537.591.5

4765. THE LATITUDE EFFECT OF THE COSMIC RAY NUCLEONIC COMPONENT IN RELATION TO THE MAGNETIC DIP.

A.E.Sandström.

Ark. Fys., Vol. 14, Paper 25, 409-18 (1958).

Concerned with data collected by means of an airborne monitor during a flight across the north polar region and around Asia and Europe. The cosmic-ray intensity values have been normalized by means of the monitors in Uppsala and on Mt. Norikura and Zugspitze. The difference between the three sets of normalized values turn out to be comparatively unimportant. The latitude effect is studied as a function of the dip. Some discrepancies are discussed as well as the influence of a possible longitude effect. By comparing the geographical coordinates of points of equal cosmic-ray intensity it is demonstrated that the effective field causing the latitude effect cannot easily be represented by a simple dipole model. Instead the true geomagnetic field, as represented by the dip, appears to be a good first approximation of the field determining the cut-off of the primaries. Anomalies can be ascribed to the fact that the tracks of the primaries, from being at first determined by a dipole field, gradually enter a part of the geomagnetic field differing very little from that at the surface of the earth.

537.591.5

4766. ATMOSPHERIC EFFECTS ON COSMIC RAY INTENSITY AT SEA LEVEL.

P.M.Mathews.

Canad. J. Phys., Vol. 37, No. 2, 85-101 (Feb., 1959).

Cosmic ray intensity variations of primary origin and those caused by meteorological changes appear superposed in records obtained from meson counter telescopes and neutron monitors at sea level. The study of either of these types of variation is thus greatly complicated by the presence of the other. In the present work, the step is taken of processing the raw data to eliminate primary variations (and the inherent statistical fluctuations) so as to make possible a direct comparison of the remaining variations with the changes in atmospheric variables over the same period. The subsequent analysis confirms the expectation that there are no appreciable atmospheric effects on the intensity of the nucleonic component beyond the well-known effect associated with the sea level barometric pressure B. But in the meson case there is strong evidence that the widely used set of variables H_{100}, T_{100} (the height and temperature of the 100 mb level) and B is not very suitable for representing atmospheric effects; it seems essential to include a variable representing temperatures in the lower part of the atmosphere, and the set of variables T_{800} (temperature of the 800 mb layer), H_{100}, and B, with coefficients $k_T = -0.082 \pm 0.008\%$ per deg. C, $k_H = -3.04 \pm 0.61\%$/km, and $k_B = -0.134 \pm 0.004\%$/mb appears to be the best. The theoretical formula of Dorman (1957), with a barometric coefficient $\beta = -0.147 \pm 0.004\%$/mb and with the term representing the "temperature effect" reduced by a factor 0.76 ± 0.03, gives slightly better results. However, the improvement, at least in the case of the data analysed, is too small to justify the great labour involved in using this formula.

537.591.5

4767. COSMIC-RAY LATITUDE SURVEY ALONG 145° EAST LONGITUDE USING AN AIRBORNE NEUTRON MONITOR.

J.R.Storey.

Phys. Rev., Vol. 113, No. 1, 297-301 (Jan. 1, 1959).

Describes a survey of the cosmic-ray nucleonic component along the 145° E longitude between geographic latitudes 34° N (Tokyo) and 52° S. The instrument used was a Simpson-type neutron monitor installed in a Lincoln bomber and measurements were made at a pressure altitude of 20 000 ft (475 g cm^{-2}). A check on the equipment performance was provided by covering the entire route twice. A Forbush-type intensity decrease was encountered during the southbound section between latitudes 5° S and 36° S. The cosmic-ray equator was located at 7.1° N geographic (2.4° S geomagnetic) and the south cosmic-ray knee, defined as the latitude south of which there is no further increase of intensity with latitude, occurred at 43.5° S geographic (52.3° S geomagnetic). The survey north of Melbourne (38° S geographic) was completed between July 18 and August 6, 1957. Flights south from Melbourne were made on August 19 and 21, 1957.

537.591.5

4768. LATITUDE DEPENDENCE OF A FORBUSH-TYPE COSMIC-RAY INTENSITY DECREASE OBSERVED AT AIRCRAFT ALTITUDE.

J.R.Storey.

Phys. Rev., Vol. 113, No. 1, 302-4 (Jan. 1, 1959).

During an aerial survey of the cosmic-ray nucleonic component along the longitude 145° E (see preceding abstract), two southbound flights between geographic latitudes 5° S and 36° S were made under depressed cosmic-ray intensity following the Forbush-type decrease commencing August 4, 1957. Comparison of the intensity versus latitude plot with that obtained during the northbound flights over the same route when quiet cosmic-ray conditions prevailed enabled the latitude dependence of the decrease was independent of latitude over the range 5° S to 36° S geographic (14° S to 45° S geomagnetic) at the altitude of observation (475 g cm^{-2}). However, comparison of data from two fixed stations, Lae (16° S geomagnetic) and Hobart (52° S geomagnetic), showed that this latitude independence did not extend to sea level.

537.591.5

4769. VARIATIONS IN THE COSMIC-RAY RIGIDITY SPECTRUM.

K.G.McCracken.

Phys. Rev., Vol. 113, No. 1, 343-8 (Jan. 1, 1959).

Variations in the counting rates of two different high-latitude neutron monitors, a high-latitude meson telescope, and a low-latitude neutron monitor were studied for the period August, 1956, to January, 1958. A long-term decrease in counting rate was observed at all stations, superposed on which there were numerous short-term variations of from 3 to 30 days duration. The long-term variation in neutron counting rate at high latitudes was four times greater than that at low latitudes, indicating that the change in the cosmic-ray spectrum was most pronounced at low rigidities. The high-latitude short-term variations in neutron counting rate were about 2.5 times greater than those at low latitudes, the ratio varying from event to event. This is interpreted as evidence that the spectrum changes during short-term variations are less strongly dependent upon rigidity than in the case of the long-term variation, and that they are of a variable character. Comparison of the neutron data with simultaneous meson data supports this view. It is concluded that the long- and short-term variations in intensity are produced by different mechanisms.

537.591.5 : 523.75

4770. COSMIC-RAY INCREASES ASSOCIATED WITH SOLAR FLARES. L.C.Towle and J.A.Lockwood.

Phys. Rev., Vol. 113, No. 2, 641-7 (Jan. 15, 1959).

Data from a standard I.G.Y. neutron monitor located on Mount Washington, New Hampshire, have been examined for possible increases associated with solar flares. The 0400 and 0900 impact zones have been located for both the standard centred dipole and the westward rotated centred dipole approximations. No increases $\geq 0.25\%$ have been found for the years 1956 and 1957. An additional maximum in the mean daily cycle at the time of impact zone passage has not been observed during this period. Possible explanations for this result are presented.

537.591.8

4771. SOME MEASUREMENTS OF ATMOSPHERIC NEUTRONS. J.D.Gabbe.

Phys. Rev., Vol. 112, No. 2, 497-502 (Oct. 15, 1958).

A series of airplane flights carrying neutron counters to an altitude of 700 g cm^{-2} was made at 52°20′ north geomagnetic latitude in 1955. Enriched and normal BF$_3$ counters were covered with Cd, Sn, Pyrex, and lime-glass shields. The ratios of the counting rates of the variously shielded counters are compared with the ratios calculated theoretically on a thick-shield basis using the neutron energy distribution function derived by Freese and Meyer (1953). The neutron-production data taken by Davis (1153/1951) and by Staker (1165/1951) with Pyrex-glass-envelope BF$_3$ counters are corrected for the absorption of neutrons by the boron in the Pyrex. The corrected neutron-production rates are recalculated to be 2.1 ± 0.4 cm^{-2} sec^{-1} and 0.9 ± 0.2 cm^{-2} sec^{-1} at 54°36′ and 30°24′ north geomagnetic latitude, respectively, using recent values for the various neutron cross-sections. These corrected rates agree, to within 5%, with the recent measurements reported by Soberman. The above energy distribution function was found, within the limited accuracy of the experiment, to describe the energy distribution of atmospheric neutrons.

537.591.8 : 539.12

ON THE INTERPRETATION OF JETS BY THE EXCITED NUCLEON MODEL. See Abstr. 3737

537.591.8 : 539.12

ON THE SPECTRUM OF HIGH ENERGY COLLISION ELECTRONS FROM μ-MESONS UNDERGROUND. See Abstr. 3759

MAGNETISM

538.083.9

4772. ON A SENSITIVE MAGNETIC FIELD MEASURING APPARATUS USING THE SECOND HARMONIC PRINCIPLE. A.Mager.

Exper. Tech. der Phys., Vol. 1, No. 3, 109-20 (Oct., 1953).
In German.

Describes the principle of the 2nd harmonic type of magnetic field measuring apparatus, equipment based on this principle, and some applications. A.E.De Barr

538.1 : 621.318.433

4773. AIR-CORED COILS FOR THE PRODUCTION OF VERY STRONG CONSTANT MAGNETIC FIELDS. CALCULATIONS AND APPLICATIONS. I. CLASSIFICATION AND USE OF AIR-CORED COILS. METHODS OF EXCITATION. CALCULATION OF WINDINGS. F.Gaume.

J. Rech. Cent. Nat. Rech. Sci., No. 43, 93-115 (June, 1958).
In French.

In an introduction the advantages and disadvantages of air-cored coils are discussed, together with the methods of excitation normall employed. Then the methods of winding are considered — particularly the shape of the winding and the distribution of current in the winding. Previous work is referred to and a complete review of this aspect of the subject is given. Attention is drawn to one type of winding that has not previously been discussed. A.E.De Barr

538.1 : 621.318.433

4774. AIR-CORED COILS FOR THE PRODUCTION OF VERY STRONG CONSTANT MAGNETIC FIELDS. CALCULATIONS AND APPLICATIONS. II. COOLING OF WINDINGS. ELECTROMAGNETI FORCES. SIMILARITY RELATIONS. F.Gaume.

J. Rech. Cent. Nat. Rech. Sci., No. 44, 247-71 (Sept., 1958).
In French.

For Pt I, see preceding abstract. A full discussion of the principles of cooling the windings of an electromagnet, with formulae, nomograms and numerical results. The forces acting on the conductors, and their effects are also discussed. The similarity relations existing between the various parameters characterizing windings of different dimensions are considered, and the use of these relations to enable small-scale studies of magnet performance to be made is discussed. A.E.De Barr

538.114

4775. ON THE THEORY OF FERROMAGNETISM. I. THE COLLECTIVE ELECTRON MODEL. K.Meyer.

Z. Naturforsch., Vol. 12a, No. 10, 786-97 (1957). In German.

The statistical thermodynomics of the collective electron model is worked out in detail and Stoner's procedure justified.

D.M.Edwards

538.114

4776. ON THE THEORY OF FERROMAGNETISM. II. THE HEISENBERG MODEL. K.Meyer.

Z. Naturforsch., Vol. 12a, No. 10, 797-804 (1957). In German.

A statistical calculation is based on an approximation to the energy levels of the Heisenberg model, the energy depending only on the spin component S^z of the system (energieschwerpunktmethode). The results obtained are those of the Weiss theory.

D.M.Edwards

538.114

4777. LINEAR ANTIFERROMAGNETIC CHAIN WITH ANISOTROPIC COUPLING. R.Orbach.

Phys. Rev., Vol. 112, No. 2, 309-16 (Oct. 15, 1958).

The exact solution is given for a linear chain of N atoms of spin $\frac{1}{2}$ coupled together by the anisotropic Hamiltonian

$$\mathfrak{H} = 2J\sum_{i=1}^{N}[S_i^zS_{i+1}^z + (1-\alpha)(S_i^xS_{i+1}^x + S_i^yS_{i+1}^y)].$$

The energy of the antiferromagnetic ground state is computed and comparison is made with a variational method. The parameter α is allowed to vary between 0 and 1, regulating the relative amount of Ising anisotropy. The short-range order, $\Sigma_i S_i^z S_{i+1}^z$, is calculated exactly from the variation of the ground-state energy with α. It is shown that a kink in the short-range order curve calculated using the variational method is fictitious, and the associated discontinuity $\partial^2 D/\partial\alpha^2$ is nonexistent. A discussion is given of long-range order and criticisms are presented regarding the predictions of the variational method.

538.114

4778. SUSCEPTIBILITY OF THE ISING MODEL OF AN ANTIFERROMAGNET. M.F.Sykes and M.E.Fisher.

Phys. Rev. Letters, Vol. 1, No. 9, 321-2 (Nov. 1, 1958).

A rearrangement of the series for the susceptibility χ in the case of spin $\frac{1}{2}$ enables the authors to conclude that $d\chi/dT = +\infty$ at the critical temperature T_c where the specific heat anomaly occurs.

D.M.Edwards

538.2 : 538.653.1

4779. ON THERMODYNAMIC IRREVERSIBLE PROCESSES OF POLARIZED MAGNETOELASTIC MEDIA. II. K.B.Vlasov.

Fiz. Metallov i Metallovedenie, Vol. 5, No. 3, 385-9 (1957).
In Russian.

Relations between the kinetic coefficients are derived for the case of an isotropic magnetoelastic medium polarized in the initial state by a magnetic field. Symmetry considerations divide the coefficients into even and odd functions of the magnetic field strengths. Equations are obtained for all the coefficients required to specify the symmetric and antisymmetric parts of the stress tensor, and their properties are studied in detail. M.J.Kearsley

538.22

4780. LOW-TEMPERATURE ELECTRICAL AND MAGNETIC BEHAVIOR OF DILUTE ALLOYS: Mn IN Cu AND Co IN Cu.

I.S.Jacobs and R.W.Schmitt.

Phys. Rev., Vol. 113, No. 2, 459-63 (Jan. 15, 1959).

Measurements are reported of the remanent magnetization in a 1.8 atom per cent Mn in Cu alloy at 4.2°K and of the low-temperature resistance, magnetoresistance, and magnetization of solid solution alloys of 0.5, 1.0, and 2.0 atom per cent Co in Cu. The isothermal remanence of the Cu(Mn) alloy saturates at about 3×10^{-2} (μ_B/Mn atom) after application of a field of about 14 kOe, and does not increase after application of pulsed fields up to 140 kOe. It is equal to the saturation thermoremanence obtained after cooling in fields ≥ 1.5 kOe. Both remanences reverse in relatively low fields of about 2 kOe. The magnetoresistance and magnetization of the Cu(Co) alloys obey the relation, $\Delta\rho = -b\sigma^2$, found previously for Cu(Mn) alloys, with b temperature-independent in contrast to that for Cu(Mn). The low-temperature resistivity of the Cu(Co) alloys increases with decreasing temperature and no maximum occurs down to 1.6°K. The magnetization of the Cu(Co) alloys shows neither remanence nor hysteresis but is nonlinear with field and with concentration. Comparison of results on these systems with existing theories delineates the areas of agreement and of disagreement.

538.221 : 537.311.33

4781. THE SUSCEPTIBILITY OF LEAD TELLURIDE PbTe.

M.Matyáš.

Czech. J. Phys., Vol. 8, No. 3, 301-8 (1958).

The results are given of the measurement of the temperature dependence of the susceptibility of samples of n- and p-type PbTe, containing either an excess of one or other of the components or ions Cl^-, or Ag^+, as impurities. The concept of cation or anion vacancies, which can be occupied by a hole or electron, Ag^+ or Cl^- ions, was employed, in addition to the constants taken from other measurements, to explain the dependencies measured.

538.221 : 537.311.33

4782. THE SUSCEPTIBILITY OF SELENIDES AND TELLURIDES OF HEAVY ELEMENTS.

M.Matyáš.

Czech. J. Phys., Vol. 8, No. 3, 309-14 (1958).

The temperature dependence of the susceptibility $\chi(T)$ of samples of PbSe, Sb_2Se_3, Sb_2Te_3, Bi_2Se_3 and Bi_2Te_3 was measured. The connection between the molar susceptibility of the characteristic crystal lattice of these semiconductors and the total number of electrons in their molecules is pointed out.

538.221

4783. NEUTRON STUDIES OF MAGNETISM.

M.Ericson, P.G.De Gennes, A.Herpin, B.Jacrot and P.Mériel.

J. Phys. Radium, Vol. 19, No. 7, 617-23 (July, 1958). In French.

Describes two series of experiments on neutron scattering by magnetic substances. Series A gives the antiferromagnetic structure of $FeCl_2$, and the effect of a magnetic field on the spin orientations as measured with a crystal spectrometer. In series B, the critical magnetic scattering of iron near the Curie point was investigated with a time of flight spectrometer. The result gives both the range of the spin correlations and the scattering constant which is related to their decay in time.

538.221 : 539.27

4784. NEUTRON DIFFRACTION INVESTIGATIONS OF THE MAGNETIC ORDERING IN $FeBr_2$, $CoBr_2$, $FeCl_2$, AND $CoCl_2$.

M.K.Wilkinson, J.W.Cable, E.O.Wollan and W.C.Koehler.

Phys. Rev., Vol. 113, No. 2, 497-507 (Jan. 15, 1959).

Neutron diffraction experiments have been performed on anhydrous $FeBr_2$, $CoBr_2$, $FeCl_2$, and $CoCl_2$, at temperatures from 295°K to 4.2°K to investigate the existence of magnetic ordering in these hexagonal layer-type structures. All four compounds have an antiferromagnetic transition at low temperatures to structures in which the atomic magnetic moments within a metal layer form ferromagnetic sheets and the moments in adjacent layers are antiparallel. In the iron compounds the moments are oriented parallel to the hexagonal c-axis and in the cobalt compounds the moment orientation is perpendicular to that axis. Values of the atomic magnetic moments are close to those expected for the divalent metallic ions if the orbital contribution is quenched. Small-angle scattering experiments on $FeCl_2$ and $CoCl_2$ have shown that the ferromagnetic coupling between moments within a layer is much stronger than the antiferromagnetic coupling between atoms in adjacent layers, and single-crystal investigations on these two compounds have determined the method by which large net magnetization values are obtained at temperatures below T_N in moderate magnetic fields.

538.221 : 538.652

4785. MAGNETOSTRICTION OF LOW-DENSITY COBALT RONDEL.

H.E.Stauss.

J. appl. Phys., Vol. 29, No. 12, 1690-1 (Dec., 1958).

A dimensional change that simulates magnetostriction can be expected when a porous or spongy ferromagnetic body is placed in a magnetic field. Such an effect was observed. Polycrystalline cobalt with a density less than 50% of normal developed a strain of -139×10^{-6}, whereas cobalt of normal density developed a strain of -28×10^{-6}. This finding appears to open the way for the development of materials with enhanced values of strain in a magnetic field.

538.221 : 538.652

4786. MAGNETOSTRICTION CONSTANTS OF NICKEL–COPPER AND NICKEL–COBALT ALLOYS.

M.Yamamoto and T.Nakamichi.

J. Phys. Soc. Japan, Vol. 13, No. 2, 228-9 (Feb., 1958).

Values of λ_{100} and λ_{111} have been obtained at room temperature in single crystal specimens by the strain gauge technique. For Ni–Cu, the constants are always negative but the absolute values decrease steadily and vanish at 35% Cu. In Ni–Co, λ_{111} is always negative and exhibits a shallow minimum at 30% Co, whilst λ_{100} increases almost linearly, is zero at 20% Co and $+116 \times 10^{-6}$ at 55% Co.

D.J.Oliver

538.221

4787. MAGNETIC AFTER-EFFECT DUE TO QUENCHED-IN VACANCIES IN NICKEL.

Y.Nakamura and J.Takamura.

J. Phys. Soc. Japan, Vol. 13, 316 (March, 1958).

Following a quench from about 1000°C the intensity of magnetization recovered about 80% of its initial value in 1 day but further recovery took place only slowly, the change being complete in about 10 days. Similar changes in volume occurred.

D.J.Oliver

538.221

4788. SHAPE DISTRIBUTION OF MAGNETIC POWDERS.

C.E.Johnson, Jr and W.F.Brown, Jr.

J. appl. Phys., Vol. 29, No. 12, 1699-701 (Dec., 1958).

In work reported earlier (Abstr. 8888/1958) the average length-to-diameter ratios determined magnetically did not agree with those observed under the electron microscope; this was thought due to magnetic interactions. This paper describes further shape determination measurements on γ-Fe_2O_3 samples of increasing dilution by the original method and by two analogous methods described by Wohlfarth (Abstr. 3222/1958). The results show a slight increase of mean length-to-diameter ratio with dilution and a considerable broadening of the distribution toward large length-to-diameter ratios. The different methods of measurement described do not yield the expected congruent curves at very low concentration. This indicates a deviation from Stoner–Wohlfarth rotation in these particles. The details of the mathematical methods are also described.

538.221 : 538.662.15

4789. TEMPERATURE DEPENDENCE OF THE SPONTANEOUS MAGNETIZATION IN SMALL FERROMAGNETIC PARTICLES.

E.Kneller.

Z. Phys., Vol. 152, No. 5, 574-85 (1958). In German.

The magnetization curve, at constant temperature, of a "superparamagnetic" alloy can be described in terms of a modified Langevin function which can be calculated on the basis of an assumed distribution of particle sizes. The Curie temperature of small ferromagnetic particles varies with temperature in a way similar to that in which the Curie temperature of thin ferromagnetic films depends upon film thickness. The reduced spontaneous magnetization of small ferromagnetic particles varies with the reduced temperature in the same way as for bulk material. Combining these effects, the temperature dependence of the magnetization of a superparamagnetic alloy can be calculated and compared with observations.

A.E.De Barr

538.23

4790. THE ENERGY OF MAGNETIZATION.

R.Vautier.

J. Rech. Cent. Nat. Rech. Sci., No. 38, 23-9 (March, 1957). In French.

The energy of magnetization is analysed with particular reference to a permanent magnet circuit with an air-gap. The relations between the total energy of magnetization and the energy of the demagnetizing field, and the area under different portions of the B–H loop, are considered.

A.E.De Barr

538.23

4791. MAGNETIC VISCOSITY DISPLAYED ON HYSTERESIS LOOP TRACES.

R.G.George.

Nature (London), Vol. 183, 245 (Jan. 24, 1959).

Reports results of hysteresis loop observations on a polycrystalline square loop ferrite under the action of superposed pulsed and a.c. fields. Discontinuities in the slope of the loops at the points of application of the pulses are ascribed to magnetic viscosity effects. E.P.Wohlfarth

538.24 : 537.312.62

4792. MAGNETIZATION CURVES OF SUPERCONDUCTIVE TIN ALLOYS. E.A.Lynton and B.Serin.
Phys. Rev., Vol. 112, No. 1, 70-2 (Oct. 1, 1958).

A previous investigation of flux trapping (Abstr. 6653/1956) has been supplemented by obtaining the magnetization curves of very fine impure tin wires in a transverse external field. For annealed specimens (containing In, Bi, or Cd) in which the impurity is completely dissolved and homogeneously distributed, it was found that some flux is frozen-in in decreasing magnetic field when the external field equals half the critical value. However, this flux leaks out monotonically as the field is further reduced, and none remains in zero field. In pure specimens virtually no flux trapping occurs. However, in a specimen containing more Cd than was completely soluble, considerable flux remains frozen-in even in zero field. These results confirm the previous inference that suitably prepared and annealed homogeneous alloy specimens are incapable of freezing-in appreciable amounts of magnetic flux. It is further concluded that this is due to the fact that the flux which is initially trapped when the specimens begin to become superconducting readily leaks or migrates out, probably because of the tendency of lines of force to contract as suggested by Faber and Pippard.

538.242

4793. MEASUREMENT OF THE GYROMAGNETIC EFFECT WITH MACROSCOPIC AND MICROSCOPIC SUPERCONDUCTING LEAD SPHERES. R.Doll.
Z. Phys., Vol. 153, No. 2, 207-36 (1958). In German.

Describes careful measurements on spheres 0.28 cm in diameter, and on colloidal suspensions in paraffin of spheres 10^{-5} to 10^{-6} cm in diameter. The values of e/m obtained with the large spheres agreed with the free-electron value to within 1%; with the colloidal suspensions the effect was too small to detect, and was certainly less than one-seventh of that expected from the London theory, allowing for the spread in particle size. R.G.Chambers

538.245

4794. THE INTERACTION ENERGY OF PARALLEL BLOCH WALLS. J.Kaczér.
Czech. J. Phys., Vol. 8, No. 3, 278-84 (1958).

The paper gives an exact calculation of the interaction energy of parallel 180° Bloch walls of an unbounded uniaxial ferromagnetic as a function of their distance and of the external field. The general relation, valid for a periodic domain structure, is applied to the special case of two Bloch walls.

538.245

4795. DEMONSTRATION OF MAGNETIC DOMAINS.
J.F.Dillon,Jr and H.E.Earl.
Amer. J. Phys., Vol. 27, No. 4, 201-8 (April, 1959).

The advant of transparent ferrimagnetic materials has made possible the direct observation of magnetic domains with a polarizing microscope. A description is given of a simple self-contained polarizing microscope suitable for demonstrating the behaviour of domains. The procurement of crystals and the actual specimen preparation are discussed. With this demonstration one can observe many of the properties of magnetic domains; the influence of external fields, of changes in magnetization, and the influence of imperfections on domain structure, to name a few. The authors suggest that the use of such a demonstration microscope as an instructional aid should facilitate greatly the teaching of magnetism on a relatively fundamental plane.

538.245

4796. ON THE THEORY OF THE DOMAIN STRUCTURE OF THIN FILMS OF MAGNETICALLY UNI-AXIAL MATERIALS.
Z.Málek and V.Kamberský.
Czech. J. Phys., Vol. 8, No. 4, 416-22 (1958).

The demagnetizing energy is calculated for a simple model of the domain structure, the axis of easy magnetization of the film being perpendicular to the surface. The width of the domain and, for the case of MnBi, the total energy of the domain structure are found as functions of the thickness of the film.

538.245 : 539.319

4797. MAGNETIC DOMAIN STRUCTURE IN Si–Fe CRYSTALS WITH INTERNAL STRAIN. W.Stephan.
Exper. Tech. der Phys., Vol. 5, No. 4, 145-162 (1957). In German.

A study of domains, by the Bitter-figure technique, in Si–Fe crystals in which internal strain was produced by quenching or mechanical polishing. The magnitude of the internal strain was deduced and its variation with depth determined. J.Thew

538.2

4798. MAGNETIC ANISOTROPY CONSTANT OF YTTRIUM IRO GARNET AT 0° K. B.R.Cooper.
Phys. Rev., Vol. 112, No. 2, 395-6 (Oct. 15, 1958).

The anisotropy energy of yttrium iron garnet is separated into two parts, the normal part predominant at high temperatures, and anomalous part important below 50° K. By comparison with ferrite data, the cause of the normal anisotropy is expected to be the coupling of the Fe^{3+} ions to the crystalline field. The following expressions for K_1, the first-order anisotropy constant, as a function of the fine structure coupling constants a_{24} (tetrahedral sites) and a_{16} (octahedral sites) is obtained: K_1/unit cell = $-46.6a_{24}-13.6a_{16}$.

538.2

4799. LOW-TEMPERATURE TRANSITION OF MAGNETIC ANISOTROPY IN NICKEL–IRON FERRITE.
N.Menyuk and K.Dwight.
Phys. Rev., Vol. 112, No. 2, 397-405 (Oct. 15, 1958).

A study of the magnetic properties of single crystal samples with the composition

$$Fe_{1.00}{}^{3+}[Ni_{0.79}{}^{2+}Fe_{0.36}{}^{2+}Fe_{0.90}{}^{3+}]O_4$$

has revealed an abrupt transition in the magnetic anisotropy characteristics at 10° K. Above this temperature the anisotropy energy is small and has cubic symmetry; below 10° K the anisotrop energy increases rapidly with decreasing temperature and contains a uniaxial annealing term in addition to the cubic terms. The uniaxial term is of the form $\Sigma_i\alpha_i{}^2\beta_i{}^2$, where α_i and β_i are the directio cosines of the magnetization at the measuring temperature and at the measuring temperature and at the annealing temperature, respectively. The observed characteristics of this material below th transition cannot be explained on the basis of long-range order. A model is proposed which assumes the excess cations of the sample to be located at normally vacant octahedral lattice sites. The theo of magnetic anneal introduced by Taniguchi and Yamamoto, and independently by Neel, is then applied to this model. The resulting predictions are in accord with our experimental findings.

538.245 : 539.

ANTIFERROMAGNETIC ANISOTROPY ENERGY IN MnF_2.
See Abstr. 4057

538.24

4800. MAGNETIZATION STUDIES AND POSSIBLE MAGNETIC STRUCTURE OF BARIUM FERRATE III. W.E.Henry.
Phys. Rev., Vol. 112, No. 2, 326-7 (Oct. 15, 1958).

An approach to the absolute saturation magnetization of polycrystalline, magnetically hard $BaO{\cdot}6Fe_2O_3$ was achieved by using magnetic fields up to 60 000 gauss and temperatures down to 1.3° K where the saturation magnetization and remanence (about one-half o the saturation magnetization) become temperature-independent. Th magnetization in the highest fields approaches 1.64 Bohr magnetons per atom of Fe at 1.3° K and 1.13 at 295° K. Inferences are drawn as to a possible magnetic structure from such a saturation magnetization. A sample displacement ballistic technique is used.

538.24

4801. MAGNETIC STRUCTURE OF Fe_4N. B.C.Frazer.
Phys. Rev., Vol. 112, No. 3, 751-4 (Nov. 1, 1958).

Examined in a neutron diffraction study. The results are in agreement with a model proposed by Wiener and Berger on the basis of magnetic measurements on a series of related compounds. Ferromagnetically aligned moments of $3\mu_B$ and $2\mu_B$ are found for the corner and face-centre Fe atoms (respectively) in the cubic unit cell. The difference in moments is apparently due to bonding interaction between nitrogen, at the body-centre position, and the face-centre Fe atoms.

538.245

4802. SYMMETRY OF MAGNETIC STRUCTURES: MAGNETIC STRUCTURE OF CHALCOPYRITE.
G.Donnay, L.M.Corliss, J.D.H.Donnay, N.Elliott and J.M.Hastings.
Phys. Rev., Vol. 112, No. 6, 1917-23 (Dec. 15, 1958).

The transformation properties of magnetic moments under symmetry and antisymmetry operations lead to 1421 possible space groups for ferromagnetic and antiferromagnetic crystal structures. A systematic procedure for magnetic structure determination is proposed, which takes into account the restrictions imposed on spin directions by space groups. This method is applied to chalcopyrite, $CuFeS_2$, which is found to be antiferromagnetic at room temperature: the chemical structure is that proposed by Pauling and Brockway, the space group $I\bar{4}2d$ holds for the magnetic structure, in which the two iron (and possibly also the two copper) atoms tetrahedrally bonded to a common sulphur atom have antiparallel spins directed along the c axis. A value of 3.85 μ_B is found for the iron moment (0 ± 0.20 μ_B for copper). The possible existence of a second chalcopyrite modification in nature, suggested by conflicting results on material of Japanese origin, is ruled out, as specimens from both Ugo, Japan and Joplin, Missouri are found to have the same structure.

538.27 : 539.2

4803. THE EFFECT OF DISLOCATIONS ON THE INITIAL PERMEABILITY OF NICKEL IN THE RECRYSTALLIZED AND IN THE PLASTICALLY DEFORMED STATE. M.Kersten.

Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 337-44 (1957). In German.

The variation with temperature of the initial permeability of recrystallized Ni between −180°C and 200°C is explained by considering the cylindrical distortion of Bloch walls between dislocations. The model can also be applied to plastically deformed and incompletely recrystallized Ni over a smaller temperature range, the upper temperature limit decreasing to about room temperature with increasing deformation. J.Franks

538.27 : 538.69

4804. MAGNETIC RESONANCE.

J. Phys. Radium, Vol. 19, No. 11, 797-910 (Nov., 1958). Also published as Colloques Internationaux du Centre Nationale de la Recherche Scientifique No. 86 (13 Quai Anatole-France, Paris 7). In French.

This international symposium was held in Paris on July 7-9, 1958. The 25 papers are mainly on nuclear and paramagnetic resonance. Abstracts of the individual papers will be published later.

538.245 : 537.226.2

THE COMPLEX DIELECTRIC CONSTANT AND PERMEABILITY OF Ni—Cd FERRITE SYSTEM AT MICROWAVE FREQUENCIES. See Abstr. 4548

538.27 : 538.69

4805. A SPECTROMETER FOR STUDYING PARAMAGNETIC AND FERROMAGNETIC RESONANCE IN THE 8700-9500 MHz BAND. Z.Frait.

Czech. J. Phys., Vol. 7, No. 2, 222-33 (1957). In Russian, with summary (1 p.) in English.

538.27 : 538.69

4806. MAGNETIC RESONANCE OF POLYCRYSTALLINE COBALT AT 35.5 kMc/s AS A FUNCTION OF TEMPERATURE. G.Asch.

C.R. Acad. Sci. (Paris), Vol. 248, No. 6, 781-4 (Feb. 9, 1959). In French.

The resonance field was measured between 190° and 670°K and reaches a maximum at 530°K, the isotropy point. The g value derived, 2.18 ± 0.03, was compared with that derived from g'. The temperature variation of the line width was also measured and reaches a minimum at 530°K. E.P.Wohlfarth

538.27 : 538.69

4807. ON THE PROBLEM OF NON-HOMOGENEITY OF DEMAGNETIZING FIELDS IN FERROMAGNETIC RESONANCE. Z.Frait.

Czech. J. Phys., Vol. 8, No. 1, 113-18 (1958). In Russian.

Proposes a method for quantitatively calculating the influence of the inhomogeneity of demagnetizing fields on the shape of resonance curves. General expressions are given for the components of the mean complex permeability. The components of the mean effective permeability are calculated and plotted for a special case (thin band of ferromagnetic metal pressed to a rectangular opening of the resonance cavity of mode H_{0Ln}). It is shown that not only broadening of the resonance curve occurs as a result of the inhomogeneities, but that the magnitude of the g-factor, determined from the maximum μ_R, differs from the correct value. Attention is drawn to the role played by this phenomenon in ferromagnetic resonance of polycrystalline ferrites.

538.27

4808. DIRECT OBSERVATION OF SPIN-WAVE RESONANCE. M.H.Seavey, Jr and P.E.Tannenwald.

Phys. Rev. Letters, Vol. 1, No. 5, 168-9 (Sept. 1, 1958).

The effect of exchange interactions in ferromagnetic resonance is experimentally shown by means of a uniform microwave field (8890 Mc/s) absorbed in a film of 80%-20% Permalloy 5600 A thick. The resonances at various magnetic field values are interpreted as spin waves obeying a dispersion law $\omega = (2A\gamma/M)k^2 + \omega_0$ and the Kittel condition for spin-wave resonance (Abstr. 411/1959) $k = p\pi/L$. A is the exchange coupling constant which can thus be obtained from the location of the spin-wave peaks, L the film thickness and p an integer. H.Motz

538.27 : 538.69

4809. FERROMAGNETIC RESONANCE IN WIRE SHAPED SPECIMENS. V.Zehler.

Z. Naturforsch., Vol. 12a, No. 5, 433-7 (May, 1957). In German.

The influence of a magnetic field on the resonance frequency and Q factor of a resonant cavity with ferromagnetic walls, is calculated including the effect of a ferromagnetic damping term. The construction of a coaxial resonant cavity suitable for investigating the damping of ferromagnetic resonance in wire specimens is described. A.J.Manuel

538.27 : 538.69

4810. THE DAMPING OF FERROMAGNETIC RESONANCE IN Ni—Fe WIRES. V.Zehler.

Z. Naturforsch., Vol. 12a, No. 5, 437-40 (May, 1957). In German.

The cavity resonator described (see preceding abstract) was used to investigate the damping of ferromagnetic resonance in Ni—Fe wires containing 68.75% Ni. Marked difference in the dispersion and absorption curves for the cavity resonator were observed using a wire successively annealed, electropolished, strained and re-annealed. A.J.Manuel

538.27 : 538.69

4811. THE VARIATION OF THE WIDTH OF THE ABSORPTION CURVE OF YTTRIUM IRON GARNET WITH SUBSTITUTION OF Cr^{3+}. R.Vautier and A.J.Berteaud.

C.R. Acad. Sci. (Paris), Vol. 247, No. 19, 1574-7 (Nov. 10, 1958). In French.

Measurements were made at 8915 Mc/s. The variations can be explained by the variation of density with the percentage of chromium. D.J.Oliver

538.27 : 538.69

4812. FERRIMAGNETIC RESONANCE IN YTTRIUM IRON GARNET AT LIQUID HELIUM TEMPERATURES. J.F.Dillon, Jr.

Phys. Rev., Vol. 111, No. 6, 1476-8 (Sept. 15, 1958).

Ferrimagnetic resonance experiments were performed on single crystal spheres of yttrium iron garnet $[Y_3Fe_2(FeO_4)_3]$ at 24 kMc/s. At 4.2° the line width measured with the steady field along [100] is 15 Oe, as compared with 30 Oe at 295°, 400 Oe at 65°K. At liquid helium temperatures the crystal is apparently cubic. There is a strong anisotropy in line width. Except for the case of the field along [100], the line width varies strongly with temperature in this temperature region. A large magnetocrystalline anisotropy is indicated by the variation in field for resonance with direction. This ranges over 3000 Oe. The maxima and minima in this field indicate that terms of higher order than the K_1 and K_2 terms used hitherto will be necessary for the description of the anisotropy energy surface. Thus, at 4.2°K, apparently [100], [110], and [111] are all hard directions, and the easy directions are exactly or close to [112], [221], and [123].

538.27 : 538.69

4813. MAGNETOSTATIC MODES IN FERRIMAGNETIC SPHERES. J.F.Dillon, Jr.

Phys. Rev., Vol. 112, No. 1, 59-63 (Oct. 1, 1958).

Ferrimagnetic resonance experiments (9000 Mc/s, 300°K) were performed using single-crystal spheres of yttrium iron garnet. R.F. magnetic fields of several different configurations were used to excite specific magnetostatic modes. A mounting technique was employed such as to eliminate dielectric inhomogeneities near the sample. Such inhomogeneities arise from the usual quartz or sapphire mounting rods. They have been observed to be responsible for the excitation of more complicated modes than would be expected from the unperturbed cavity fields. It was found that supposedly spherical specimens produced by the usual tumbling procedures deviate slightly from true sphericity. In these experiments highly polished truly spherical samples were used. With these conditions there is no ambiguity about the identity of the mode representing the spacially uniform precession of the entire spin system. The spacings of the various modes do not vary with the crystal direction along which H_{dc} is applied. These results contrast with those of White and Solt on manganese ferrite in several respects, viz. the clear identity of the uniform precession and the constant mode spacing for the various crystal directions.

538.27 : 538.69

4814. ON THE INFLUENCE OF ELECTRIC POLARIZATION ON THE MAGNETIC PROPERTIES OF FERRITES.

P.S.Zÿryanov and G.V.Skrotskiĭ.

Zh. eksper. teor. Fiz., Vol. 34, No. 1, 222-3 (1958). In Russian.

In ferrites, spin-orbital interactions of the d-electrons lead to a dependence of the effective magnetic susceptibility on the polarization of the electron clouds. In metals this effect is obscured, at radio frequencies, by the strong polarizability of the conduction electrons. Quantitative calculation shows a displacement of the resonance frequency and a widening of the absorption line. The calculation is a generalization of one by Ament and Rado (Abstr. 4779/1955). A.L.Mackay

538.27 : 538.69

4815. AN APPARATUS FOR THE INVESTIGATION OF PARAMAGNETIC ELECTRON RESONANCE IN CRYSTALS AND LIQUIDS.

E.Albold, B.Elschner and P.Wenzel.

Exper. Tech. der Phys., Vol. 5, No. 6, 254-61 (1957). In German.

The construction and performance of a magic—T microwave bridge spectrometer for 3 cm wavelengths is described. A.J.Manuel

538.27 : 538.69

4816. AN INVESTIGATION OF ELECTRON PARAMAGNETIC RESONANCE FOR VARIOUS MAGNETIC FIELD ORIENTATIONS. MICROWAVE MAGNETO-OPTIC EFFECTS. P.Hedwig.

Exper. Tech. der Phys., Vol. 5, No. 3, 132-43 (1957). In German.

The paper gives calculations of the microwave absorption, Faraday effect and Cotton—Mouton effect for all possible orientations of the r.f. and d.c. fields on the basis of the Bloch equations and these are claimed to be more exact than those of earlier authors. Apparatus is described for the measurement of these three parameters at 3.365 cm by well known methods although some subtleties in the interpretation are noted. High homogeneity of the microwave field is achieved by working the resonator close to cut-off. Detailed results are given for $MnSO_4$ which agree with the theory. The Cotton—Mouton effect is also demonstrated for DPPH. J.G.Powles

538.27 : 538.69 : 541.15

4817. PARAMAGNETIC RESONANCE STUDY OF IRRADIATED GLASSES OF METHANOL AND ETHANOL.

H.Zeldes and R.Livingston.

J. chem. Phys., Vol. 30, No. 1, 40-7 (Jan., 1959).

Methanol and ethanol, including some of those alcohols with deuterium substitution, were cooled to glasses at 77°K, irradiated with gamma-rays, and then examined at several temperatures in a paramagnetic resonance spectrometer. The alcohols become intensely coloured and a paramagnetic resonance spectrum associated with this colour was observed superimposed on part of an underlying spectrum. The colour can be bleached with incandescent illumination, and after bleaching the underlying three- or five-line spectrum (methanol and ethanol, respectively) becomes stronger showing that the bleachable species is a precursor for at least a portion of the species giving the underlying spectrum. The manner in which the five-line ethanol spectrum changes with temperature is discussed. Deuterium substitution shows that the hyperfine lines originate from four of the protons originally present on the carbon atoms of the parent alcohol and that a proton of the parent alcohol has left the α-carbon. Possible radicals that could explain the results are discussed.

538.27 : 538.69 : 539.19

4818. PARAMAGNETIC RESONANCE OF BIS-CYCLOPENTADIENYL VANADIUM.

H.M.McConnell, W.W.Porterfield and R.E.Robertson.

J. chem. Phys., Vol. 30, No. 2, 442-3 (Feb., 1959).

The paramagnetic resonance spectrum of a benzene solution of bis-cyclopentadienyl vanadium shows a g factor equal to 2.00 and a V^{51} isotropic hyperfine splitting equal to 77 Mc/s. The small V^{51} hyperfine splitting demonstrates that none of the three odd-electrons in this sandwich compound spends an appreciable part of its time in a 4s atomic orbital of the vanadium atom. The observed spectroscopic splitting factor shows that the orbital ground state is a singlet. This result signifies that one of tht three unpaired electrons in this substance must be in an orbital of a_{1g} symmetry, and that the other two electrons must be in orbitals of e_g symmetry. This latter conclusion is in good agreement with theoretical orbital energy levels derived by a number of investigators. The paramagnetic resonance spectrum of an air oxidation product of bis-cyclopentadienyl vanadium was observed. The spectroscopic splitting factor is g = 1.99 and the hyperfine splittings are 210 Mc/s. It is sugges that the oxidation product may be the neutral vanadyl sandwich, $VO(C_5H_5)_2$.

538.27 : 538.69 : 539

4819. DIRECT MEASUREMENT OF ELECTRON SPIN-LATTIC RELAXATION TIMES. C.F.Davis, Jr, M.W.P.Strandberg and R.L.Kyhl.

Phys. Rev., Vol. 111, No. 5, 1268-72 (Sept. 1, 1958).

A discussion of the experimental problems encountered in making spin-lattice relaxation measurements in electron paramagnetic systems at low temperature is presented. Gadolinium and chrome ion spin-lattice relaxation times, measured by a pulse saturation technique in the time domain, are given. The relation of these spin-lattice relaxation times with relaxation times measured in the frequency domain by observing a saturation parameter is discussed.

538.27 : 538.

4820. PARAMAGNETIC RESONANCE SPECTRUM OF GADOLINIUM IN HYDRATED LANTHANUM TRICHLORIDE.

M.Weger and W.Low.

Phys. Rev., Vol. 111, No. 6, 1526-8 (Sept. 15, 1958).

The paramagnetic resonance spectrum of Gd^{3+} in $LaCl_3.7H_2O$ was measured and found to agree quite well with a spin Hamiltonia with dominant coefficients $b_2^0 = \pm0.0131\ cm^{-1}$, $b_2^2 = \mp0.0075\ cm^{-1}$ at room temperature, and $b_2^0 = \pm0.0099\ cm^{-1}$, $b_2^2 = \mp0.0115\ cm^{-1}$ at liquid air temperature.

538.27 : 538.

4821. PARAMAGNETIC RESONANCE STUDY OF COPPER-DOPED SILVER CHLORIDE [CRYSTALS]. R.F.Tucker, Jr.

Phys. Rev., Vol. 112, No. 3, 725-31 (Nov. 1, 1958).

Studied at temperatures between 77°K and room temperature. The crystals were treated in various ways by illumination or halogenation. Resonances were observed in halogenated crystals which are interpreted as arising from Cu^{++} ions occupying sites which differ as to the presence and relative positions of associated vacancies. These spectra were observed to vary with temperature in a manner attributable to vacancy motion. The activation energy for this motion is estimated. An estimate is made of the amount of Cu—Cl bonding through an approximate line-width analysis. Speculations are offered as to the role of the copper ion in the photolytic process in silver chloride, and further experiments are suggested.

538.27 : 538.6

4822. MULTIPLE QUANTUM TRANSITIONS IN PARAMAGNETIC RESONANCE. P.P.Sorokin, I.L.Gelles and W.V.Smith.

Phys. Rev., Vol. 112, No. 5, 1513-15 (Dec. 1, 1958).

At high r.f. fields the normal paramagnetic resonance spectrum of Mn^{++} in cubic MgO is found to be modified by the appearance of additional absorption lines which occur at the frequencies: $(E_k - E_{k-2})/2h$. These are interpreted as double quantum transition ($\Delta M = 2$) which occur between nearly equally spaced energy levels at high r.f. power. The transitions $M = -\frac{3}{2} \rightarrow +\frac{1}{2}$ and $M = -\frac{1}{2} \rightarrow \frac{3}{2}$ were observed at both room and liquid nitrogen temperatures for a number of orientations of the crystal with respect to a d.c. magneti field of 3400 oersteds. At 77°K evidence of the triple quantum transitions $-\frac{1}{2} \rightarrow \frac{5}{2}$, $-\frac{5}{2} \rightarrow \frac{1}{2}$ was observed. Second order time-dependen perturbation theory yields a formula for the ratio of the absorption intensity of the double quantum transition to the absorption intensity for a first order transition. The predicted ratio agrees with the experimentally observed ratio.

538.27 : 538.69 : 539.2

4823. ELECTRON SPIN RESONANCE OF Mn^{++} IN ALKALI CHLORIDES: ASSOCIATION WITH VACANCIES AND IMPURITIES.

G.D.Watkins.

Phys. Rev., Vol. 113, No. 1, 79-90 (Jan. 1, 1959).

The spin resonance of Mn^{++} in LiCl, NaCl, and KCl is describe In NaCl, five different spectra are observed. Designated I, II, III_1, III_2, and IV, these arise from Mn^{++} ions in five different environments. These are identified as (I) Mn^{++} ions in an aggregated or precipated state, (II) isolated Mn^{++} ions which are not near any defect, (III_1) Mn^{++} ions with a positive ion vacancy bound in the nearest cation site, (III_2) Mn^{++} ions with a vacancy bound in the next-nearest site, and (IV) Mn^{++} ions paired off with a chemical impurity charge compensator. In LiCl and KCl only the two vacancy—Mn^{++} pairs (III_1 and III_2) are studied. In all three salts the nearest and next-nearest vacancy—Mn^{++} pairs are approximately equally stable. By studying the spectra in NaCl as the temperature is raised, the thermal dissociation of the Mn^{++}—vacancy pairs is observed, with a corresponding increase in the number of isolated Mn^{++} ions. This follows a simple mass action law giving a binding energy for the Mn^{++}–vacancy pairs of approximately 0.4 eV. An ionic point charge model of the crystalline field produced by the defects is successful in explaining several features of the spectra. However, the magnitude of the field predicted in this manner appears to be a factor of 10 too low if the recent theory of Watanabe is used. This discrepancy is attributed to the role of overlap of the ion cores and/or covalency.

538.27 : 538.69 : 539.2

4824. MOTION OF Mn^{++}-CATION VACANCY PAIRS IN NaCl: STUDY BY ELECTRON SPIN RESONANCE AND DIELECTRIC LOSS. G.D.Watkins.
Phys. Rev., Vol. 113, No. 1, 91-7 (Jan. 1, 1959).

See preceding abstract. Thermal motion of the bound positive ion vacancy around a Mn^{++} ion in NaCl was detected as a broadening of some of the multiplets in the Mn^{++} spin resonance spectrum. In addition, dielectric loss measurements at radio frequencies reveal a Debye loss peak which can be directly correlated with this motion. Analysis of these experiments gives the lifetime of the vacancy in the cation site nearest the Mn^{++} to be $1/\tau = 1.2 \times 10^{14} \exp(-E/kT)$, with $E = 0.63 \mp 0.05$ eV. Near 300°C, the lifetime of the vacancy in the next nearest site is approximately one-third less. The Mn^{++}–vacancy interchange is not detected in the resonance and therefore does not set in first. The magnitude and form of the loss peak is in good agreement with the recent theory of Lidiard if the effect of both nearest and next nearest pairs is considered.

538.27 : 538.69

4825. METHOD OF TREATING ZEEMAN SPLITTINGS OF PARAMAGNETIC IONS IN CRYSTALLINE FIELDS.
G.F.Koster and H.Statz.
Phys. Rev., Vol. 113, No. 2, 445-54 (Jan. 15, 1959).

An alternative method is presented to the "spin Hamiltonian" for treating the behaviour of a paramagnetic ion under the combined influence of the host crystal and an applied magnetic field. This method has the advantage of being applicable to all strengths of couplings between the paramagnetic ion and the surrounding crystal. It is applicable to free-ion S states in the same way that it applies to all other states. It gives all of the constants one needs to describe the energy level structure as a function of field as restricted by symmetry and the properties of the levels considered. The method is more general and is expected to be also more accurate than the conventional spin Hamiltonian formalism. It is illustrated by the application to the problem of the (d^5) ^6S level in a cubic crystalline environment.

538.27 : 538.69

4826. ELECTRON SPIN RESONANCE OF ACCEPTOR STATES IN DIAMOND. W.V.Smith, I.L.Gelles and P.P.Sorokin.
Phys. Rev. Letters, Vol. 2, No. 2, 39-40 (Jan. 15, 1959).

E.S.R. was observed, near g = 2, in natural unirradiated diamond, which is attributed to bound aluminium acceptor impurities. The unpaired electrons are located along one of the tetrahedral bond directions. Each of the four magnetically distinguishable arrangements has a hyperfine structure due to the aluminium magnetic dipole and electric quadrupole moments. The lines are only $\frac{1}{3}$ Oe wide and are easily saturated at room temperature. J.M.Baker

538.27 : 538.69

4827. PARAMAGNETIC RESONANCE DATA. J.W.Orton.
Rep. Progr. Phys., Vol. 22, 204-40 (1959).

A table of experimental paramagnetic resonance data is presented. Its purpose is to bring up to date (to the end of 1958) the results given in an earlier Progress Report by Bowers and Owen (Abstr. 8907/1955). Results are given, in the form of values for the parameters in the spin Hamiltonian, for transition group ions in solids, F centres, V centres and other damage centres. No results on paramagnetic resonance in liquids or free radicals are included.

538.27 : 538.69

4828. THE FINE AND HYPERFINE STRUCTURE OF THE SPECTRUM OF PARAMAGNETIC RESONANCE OF Cr^{3+} IN CORUNDUM. G.M.Zverev and A.M.Prokhorov.
Zh. eksper. teor. Fiz., Vol. 34, No. 2, 513-14 (1958). In Russian. English summary: PB 141052T-1, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The electron spin resonance spectrum of small quantities of Cr^{3+} in corundum is fitted to the usual axial-spin Hamiltonian with parameters $D = -0.1912 \pm 0.0010$ cm^{-1}, $g_{\parallel} = 1.982 \pm 0.002$, $g_{\perp} = 1.979 \pm 0.009$, and hyperfine structure parameters for Cr^{53} (measured on an enriched isotope 95% Cr^{53}) $A = (16.8 \pm 0.04) \times 10^{-4}$ cm^{-1} and $B = (16.8 \pm 0.06) \times 10^{-4}$ cm^{-1}. J.M.Baker

538.27 : 538.69 : 539.14

RE-EXAMINATION OF THE PARAMAGNETIC RESONANCE OF NP^{239}. See Abstr. 3817

ELECTROMAGNETISM
MAGNETOHYDRODYNAMICS

538.3 : 530.145

4829. ON THE ENERGY–MOMENTUM TENSOR FOR ELECTROMAGNETIC FIELDS. E.Blancheton.
C.R. Acad. Sci. (Paris), Vol. 248, No. 3, 372-4 (Jan. 19, 1959).
In French.

Necessary and sufficient conditions for the symmetric tensor $E^{\alpha\beta}$ to be the energy–momentum tensor of an electromagnetic field in Riemannian space–time are $g_{\lambda\mu} E^{\lambda\mu} = 0$ and $g_{\lambda\mu} E^{\alpha\lambda} E^{\mu\beta} = \sigma g^{\alpha\beta}$, where $\sigma \geq 0$. Fields defined by $E^{\alpha\beta}(x,\epsilon)$ are discussed for small ϵ, where $\epsilon = 0$ defines a singular field. R.A.Newing

538.3 : 537.311.5

CURRENT DISTRIBUTION IN INFINITE HELICOID. See Abstr. 4600

538.541 : 536.4

4830. DISCUSSION OF THE SIMPLIFYING ASSUMPTIONS INTRODUCED IN THE STUDY OF THE HEATING OF A THIN CYLINDRICAL CONDUCTING LAYER BY A HIGH FREQUENCY SINUSOIDAL UNIFORM MAGNETIC FIELD. M.Gourceaux.
C.R. Acad. Sci. (Paris), Vol. 247, No. 20, 1720-1 (Nov. 17, 1958).
In French.

538.3 : 532.5

4831. SUPERPOSABILITY IN MAGNETOHYDRODYNAMICS.
J.N.Kapur.
Appl. sci. Res. A, Vol. 8, No. 2-3, 198-208 (1959).

The concept of superposing two hydromagnetic flows is defined, and it is shown that force-free fields (Chandrasekhar) and self-superposable fluid flows (Strang) are particular cases of this concept. Chandrasekhar's equations for axially symmetric hydromagnetic flows are extended to viscous fluids. It is found that some important results for non-viscous flows need not hold for viscous fluids.

538.3 : 532.5

4832. RESOLUTION OF AN INITIAL SHEAR-FLOW DISCONTINUITY IN ONE-DIMENSIONAL HYDROMAGNETIC FLOW.
J.Bazer.
Astrophys. J., Vol. 128, No. 3, 686-712 (Nov., 1958).

The problem of the resolution of an initial shear-flow discontinuity in an infinitely conducting, compressible fluid is treated. The discussion applies equally well to a flow which is initially parallel to a perfectly conducting wall. The basis of both problems is that a shear flow is an "inadmissible" hydromagnetic contact discontinuity if a component of the magnetic field normal to the surface of discontinuity is present. The motion which results when a shear-flow discontinuity is present initially is investigated. It is shown that this motion may be described in terms of known solutions of the hydromagnetic shock and continuum equations. The dependence of the final constant state of the medium on the initial state is analysed by analytical and numerical means. Formulae for various quantities of interest are given for the limiting cases of weak and strong initial shear flows.

538.3 : 532.5

4833. MAGNETOHYDRODYNAMIC DISTURBANCES DUE TO THE SUDDEN INTRODUCTION OF A MAGNETIC DIPOLE IN A FLUID OF FINITE CONDUCTIVITY. M.G.S.el Mohandis.
Astrophys. J., Vol. 129, No. 1, 172-93 (Jan., 1959).

Mathematical solutions for the magnetohydrodynamic perturbations are given for the case of a magnetic dipole placed either parallel or perpendicular to the exciting field in an infinite fluid of finite electrical conductivity. Walen's (1944) approximation is used, and charts representing the excited field, the total field, and fluid motion are drawn.

538.3 : 532.5

4834. STUDY OF THE STABILITY OF RESLER–SEARS FLOWS.
J.Naze.
C.R. Acad. Sci. (Paris), Vol. 248, No. 3, 362-5 (Jan. 19, 1959).
In French.

One-dimensional motions of a compressible electrically conducting fluid in electric and magnetic fields at right angles to each other and to the motion are considered. The propagation of a discontinuity in acceleration is studied. Of the three stationary flows studied by Resler and Sears [Z.angew. Math. Phys., Vol. 9b, No. 5-6, 509-18 (1958)] it is found that the subsonic and supersonic flows are stable with respect to such discontinuities, but the transonic flow is stable only if accelerating. O.Penrose

538.3 : 532.5

4835. ON CERTAIN QUASI-RECTILINEAR FLOWS OF A FLUID OF FINITE ELECTRICAL CONDUCTIVITY. J.Naze.
C.R. Acad. Sci. (Paris), Vol. 248, No. 4, 525-8 (Jan. 26, 1959).
In French.

The work of a previous paper (see preceding abstract) is generalized to motion in a tube of slowly varying cross-section. Heat conduction and viscosity are neglected, but Joule heating is included. It is found that variations of cross-section do not affect the conclusions previously reached about stability, unless the conductivity is infinite or zero. O.Penrose

538.3 : 532.5

4836. ZEMPLEN'S THEOREM IN MAGNETOHYDRODYNAMICS.
S.V.Iordanskiĭ.
Dokl. Akad. Nauk SSSR, Vol. 121, No. 4, 610-12 (1958). In Russian.

The theorem states a general relationship between the normal and tangential components of the magnetic field, the current density, and the fluid density and pressure at two points in the continuum. After an outline of the general proof, this is particularized to the case of vorticity by allowing the two specified points to approach indefinitely close to each other, while remaining on opposite sides of a pressure discontinuity. J.W.Gardner

538.3 : 532.5

4837. DEVELOPMENT OF HYDROMAGNETIC SHOCKS FROM LARGE-AMPLITUDE ALFVÉN WAVES. D.Montgomery.
Phys. Rev. Letters, Vol. 2, No. 2, 36-7 (Jan. 15, 1959).

The author considers a collision-free zero-temperature plasma in which the electron Larmor radius is negligible. Plane-polarized Alfvén waves in this plasma are shown to be described by the same equations as a nonlinear sound wave in an ordinary gas, with $B^2/8\pi$ replacing the pressure, and $\gamma = 2$. The time for an Alfvén wave to develop into a shock is estimated using a result of ordinary shock theory. O.Penrose

538.3 : 532.5 : 537.56

4838. AXIALLY SYMMETRIC SOLUTIONS OF THE MAGNETOHYDROSTATIC EQUATION WITH SURFACE CURRENTS. II.
K.Jörgens.
Z. Naturforsch., Vol. 13a, No. 7, 493-8 (July, 1958). In German.

See Abstr. 1605 (1959). The magnetic field is shown to be uniquely determined by the values of the total current in azimuthal and in meridional direction respectively and by the gas pressure. A method is given to compute the location of discontinuities of the magnetic field outside of the torus. The singularities are found explicitly in the case of elliptic or circular cross-section. In the circular case the magnetic field is regular everywhere outside except on the axis of symmetry. R.A.Newing

538.3 : 532.5 : 537.56

4839. TORUS-LIKE PLASMA CONFIGURATIONS WITH ZERO CURRENT THROUGH THEIR CROSS-SECTIONS IN EQUILIBRIUM WITH A MAGNETIC FIELD. F.Meyer and H.U.Schmidt.
Z. Naturforsch., Vol. 13a, No. 12, 1005-15 (Dec., 1958). In German.

An investigation of possible equilibrium configurations for a plasma in equilibrium with an external magnetic field, the internal field being zero. The lines of flow of surface currents can be equidistant plane curves in planes parallel to the axis of the torus, but these planes do not have a common line of intersection. Possible forms of azimuthal and meridional cross-sections are determined, and a construction is devised for a deformable network which provides a model for possible equilibrium surfaces. R.A.Newing

538.3 : 532.5 : 537.56

4840. INVESTIGATION OF THE STABILITY OF A GRAVITATING PLASMA IN CROSSED MAGNETIC FIELDS. F.Meyer.
Z. Naturforsch., Vol. 13a, No. 12, 1016-20 (Dec., 1958). In German.

A plasma with an interior horizontal magnetic field is supported against gravity by a horizontal vacuum field inclined to the interior field at an angle α. This angle can be adjusted so that equilibrium is stable with respect to disturbances of small wavelength; in particular, the Kruskal—Schwarzschild instability for the case $\alpha = 0$ (Abstr. 6324/1954) can be removed by a suitable choice of α. Equilibrium is unstable with respect to disturbances of long wave length. R.A.Newing

538.3 : 532.

4841. RADIAL PULSATIONS OF AN INFINITE CYLINDER WITH FINITE CONDUCTIVITY IMMERSED IN MAGNETIC FIELD.
P.L.Bhatnagar and S.R.Nagpaul.
Z. Astrophys., Vol. 43, No. 4, 273-88 (1957).

The cylinder is immersed in a magnetic field H given by

$$H^2 = H_S^2 + (H_0^2 - H_S^2)\left\{1 - \left(\frac{r}{R}\right)^2,\right\}$$

where H_0 and H_S are the magnetic fields on the axis and on the surface of the cylinder, respectively, and r and R are the distance from the axis and the radius of the cylinder. The particular case of a uniform magnetic field is obtained by taking $H_S = H_0$, while the particular case considered by Lyttkens (Abstr. 7093/1954) corresponds to $H_S = 0$. In Lyttkens case, the magnetic field is proportional to the square root of the pressure at each point. The effect is discussed of finite conductivity on the radial pulsations of an infinite cylinder immersed in uniform magnetic field. The change in the phase of the displacement function and the amplitude of the magnetic field for $0 \leq r \leq R$ and the damping time of the first three modes for various magnitudes of the initial magnetic field are evaluated.

538.3 : 532.5 : 523.1

4842. A NOTE ON FORCE-FREE FIELDS. S.K.Majumdar.
Z. Astrophys., Vol. 47, No. 1, 44-9 (1959).

Considers a magnetohydrostatic field in an infinitely conducting incompressible medium, the field becomes force-free due to suitabl displacement of the medium. An expression for the "modes" of displacement is obtained.

538.3 : 532.5 : 537.562

HYDROMAGNETIC EQUATIONS FOR TWO ISOTOPES IN A COMPLETELY IONIZED GAS. See Abstr. 4751

ELECTROMAGNETIC WAVES AND OSCILLATIONS

538.56 : 538.221

4843. MICROWAVE RADIATION FROM FERRIMAGNETICALLY COUPLED ELECTRONS IN TRANSIENT MAGNETIC FIELDS.
F.R.Morgenthaler.
I.R.E. Trans Microwave Theory and Tech., Vol. MTT-7, No. 1, 6-11 (Jan., 1959).

Under certain restrictive conditions it appears that ferrimagnetically coupled electron spins are capable of coupling energy from a transient magnetic field and giving it up in the form of micro wave radiation. This paper analyses the behaviour of the uniform precession of motion in ferrimagnetic insulators under the influence of transient magnetic fields of changing amplitude and direction. The expected radiation power and efficiency are calculated for such an oscillator employing yttrium iron garnet.

538.565

4844. ON THE PROBLEM OF WAVE PROPAGATION IN A CHAIN OF CYLINDRICAL RESONATORS. G.N.Rapaport.
Zh. tekh. Fiz., Vol. 27, No. 9, 2105-8 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 1951-4 (Sept., 1957).

This article considers two types of equivalent circuits for a chain of resonators, and investigates qualitatively the effect of resonance of the coupling elements.

538.566 : 531.717.3 : 621.385.63 : 621.317.39

AUTOMATIC MEANS OF MEASURING AND RECORDING THE PITCH UNIFORMITY OF HELICES IN TRAVELLING WAVE TUBES. See Abstr. 4331

538.566

4845. POLARIMETRIC RESEARCHES IN THE 2000 Mc/s BAND.
P.Loudette.
Ann. Phys. (Paris), Vol. 3, No. 11-12, 965-1017 (Nov.-Dec., 1958).
In French.

A detailed description of the design of a wide-band oscillator and a waveguide equivalent of a polarimetric bench including an analyser, polarizer, quarter-wave plate etc. Experimental observation on the Cotton effect and the anomalous behaviour of ferrites are reported. J.M.Hough

538.566 : 534.26

4846. CALCULATION OF THE SCATTERING CROSS-SECTIONS OF A SPHERE AND A CYLINDER USING A MODIFIED WATSON TRANSFORMATION. P.Beckmann and W.Franz.

Z. Naturforsch., Vol. 12a, No. 7, 533-7 (July, 1957). In German.

An asymptotic series in descending powers of $(ka)^{2/3}$ is obtained. The first correction terms agree with those found by Rubinov and Wu (Abstr. 8877/1956). W.A.Hepner

538.566

4847. FAR FIELD SCATTERING FROM BODIES OF REVOLUTION. K.M.Siegel.

Appl. sci. Res. B, Vol. 7, No. 4, 293-328 (1958).

Radar scattering cross-sections for bodies of revolution are found. In the Rayleigh region (wavelength large with respect to object dimensions) approximate solutions are found. Examples given include a finite cone, a lens, an elliptic ogive, a spindle and a finite cylinder. In the physical optics region (wavelength very small with respect to all radii of curvature) Kirchhoff theory and also geometric optics can be used. When the body dimensions are only moderately large with respect to the wavelength, Fock or Franz theory can be applied, and examples of the circular and elliptic cylinder are presented. In the region where some dimensions of the body are large with respect to the wavelength and other dimensions are small with respect to the wavelength, special techniques are used. One example, the finite cone, is solved by appropriate use of the wedge-like fields locally at the base. Another example is the use of travelling wave theory for obtaining approximate solutions for the prolate spheroid and the ogive. Other results are obtained for cones, the base perimeter of which is of the order of a wavelength, by using known results for rings of the same perimeter.

538.566

4848. THE SCATTERING OF WAVES BY A LARGE SPHERE FOR IMPEDANCE BOUNDARY CONDITIONS. G.Kear.

Ann. Phys. (New York), Vol. 6, No. 1, 102-13 (Jan., 1959).

A method is presented for obtaining the amplitude of waves scattered by a sphere whose radius is large compared with the wavelength. Impedance boundary conditions are imposed on the surface of the sphere. The solution is characterized by both a discrete and continuous spectrum with the discrete spectrum expressed in terms of the radial modes, or eigenfunctions. It is shown that the discrete spectrum is cancelled by the continuous spectrum after the first few terms. Thus, a rapidly converging solution is obtained, consisting of only the first few radial modes and a definite integral. Numerical examples are given for the Dirichlet and Neumann boundary conditions in the forward direction. The frequency dependent correction terms obtained for the shadow region are in agreement with earlier results, obtained by more laborious methods.

538.566

4849. DIFFRACTION BY AN IMPERFECTLY CONDUCTING RIGHT-ANGLED WEDGE. W.E.Williams.

Proc. Cambridge Phil. Soc., Vol. 55, Pt 2, 195-209 (April, 1959).

A new and exact solution is given for the diffraction of the field of an electric line current by an imperfectly conducting wedge of exterior angle $\frac{3}{2}\pi$. Previous attempts at solving this problem assumed that the solution could be expressed as a series in inverse powers of the conductivity of the wedge, but this approach can only be applied to wedges of exterior angle less than π as the solution obtained is singular at the edge of the wedge for angles exceeding π. It is shown that in the present case no such expansion is uniformly valid; at large distances from the wedge, however, the present solution agrees with that obtained by assuming an expansion in inverse powers of the conductivity, even though this latter solution is singular at the edge, to order $(\text{conductivity of the wedge})^{-1}$; the next term in the expansion of the present exact solution is $O(\text{conductivity})^{-\frac{4}{3}}$. The case of an incident plane wave may be obtained by letting the source tend to infinity.

538.566 : 550.839

4850. RADIATION RESISTANCE OF A DIPOLE ANTENNA ABOVE A CONDUCTING PLANE, WITH A VIEW TO RADIO-GEOPHYSICAL PROSPECTION. F.Minaw.

Proc. Math. Phys. Soc. Egypt, No. 21, 93-8 (May, 1957).

A study is made of the properties of a dipole aerial above a conducting plane. It is found that the radiation resistance of the dipole increases with increase of frequency, till a maximum is reached. After this the radiation resistance varies periodically. From the frequency for the first maximum, it is possible to calculate the distance of the dipole from the conducting plane. For geophysical applications, the present investigation is used as a model for the case of a conducting bed or underground water lying under dry sand in an arid region.

538.566.2 : 523.164.85

OBSERVATIONS OF DIRECTION OF ARRIVAL OF LONG-DURATION METEOR ECHOES IN FORWARD SCATTER PROPAGATION. See Abstr. 4209

538.566.3

4851. EFFECT OF THERMAL EXPANSION OF THE F_2 REGION OF THE IONOSPHERE ON THE ABSORPTION OF HIGH FREQUENCY RADIO WAVES. S.K.Sharma.

J. sci. industr. Res., Vol. 18A, No. 1, 17-20 (Jan., 1959).

The total absorption of radio waves in the ionosphere was measured by the pulse technique at vertical incidence at different hours of the day. It was found that for frequencies below the critical frequency of the F1-layer, only one maximum of total absorption is generally observed, while at frequencies sufficiently above the critical frequency of this layer, two maxima are observed — one before and the other after the local noon. The maximum observed before hoon is attributed to the thermal expansion of the F_2 region of the ionosphere under adiabatic equilibrium, the effect of which is more pronounced in the lower latitudes.

538.566.3 : 621.396.8

4852. COMMENTS ON THE VILLARD–STEIN–YEH PAPER "STUDIES OF TRANSEQUATORIAL IONOSPHERIC PROPAGATION BY THE SCATTER-SOUNDING METHOD". R.Silberstein.

J. geophys. Res., Vol. 62, No. 4, 645-6 (Dec., 1957).

Two other instances in addition to that recorded in the paper quoted [Abstr. 4418B/1958; J. geophys. Res., Vol. 62, No. 3, 399-412 (Sept., 1957)] where very long-range echoes have been observed are cited. Possible explanations of the propagation path are given. G.M.Brown

538.566.3

4853. AN ANALYSIS OF DRIFTS OF THE SIGNAL PATTERN ASSOCIATED WITH IONOSPHERIC REFLECTIONS. D.G.Yerg.

J. geophys. Res., Vol. 64, No. 1, 27-31 (Jan., 1959).

If the signal pattern in the vicinity of three spaced receivers is assumed to be represented by a linear variation in distance and time for a short time interval τ, the apparent motion of the pattern must be normal to the lines of constant signal intensity. The instantaneous velocity of the ground pattern may be represented as the sum of the component of the average drift velocity in the direction of the gradient and a random velocity in the direction of the gradient. After the drift velocity has been determined by correlation analysis, the random velocity for each time interval may be obtained, and a spectral analysis of the random speed may be performed. This information may be used as an aid in describing the detailed motion of the signal pattern which is necessary in relating the observations to ionospheric motions.

538.566.3 : 551.510.535 : 621.396.8

4854. DISCUSSION OF THE WHEELON PAPER "RADIO FREQUENCY AND SCATTERING ANGLE DEPENDENCE OF IONOSPHERIC SCATTER PROPAGATION AT V.H.F." R.Bolgiano, Jr.

J. geophys. Res., Vol. 62, No. 4, 639-40 (Dec., 1957).

Criticism of the theoretical results of Wheelon (Abstr. 4190/1958) for the spectrum of mean square fluctuations produced by turbulent mixing of an established gradient in the inertial subrange. It is claimed that molecular diffusion cannot be neglected in this range, and allowance for this yields a different spectrum law, but the inclusion of the effect of in-mixing by eddies does not affect the law. G.M.Brown

538.566.3 : 551.510.535 : 621.396.8

4855. THE ROLE OF TURBULENT MIXING IN SCATTER PROPAGATION. R.Bolgiano, Jr.

I.R.E. Trans Antennas and Propagation, Vol. AP-6, No. 2, 161-8 (April, 1958).

The Villars–Weisskopf–Wheelon theory describing turbulent mixing of an established gradient is shown to contain a contradiction which necessitates its being discarded. To fill the gap thus created, the theory of isotropic mixing is extended to account for the presence of a gradient. The results indicate that "mixing-in-gradient" cannot be employed to explain the wavelength dependence characteristic of much of the radio data. On the other hand, it is shown that experimentally determined spectra of refractive index fluctuations lend strong support to the mixing theory herein set forth. Hence, the conclusion is reached that scatter theory, as it is currently based on atmospheric turbulence, can provide, at best, an incomplete description of transhorizon propagation.

538.566.3 : 621.396.8

4856. INVESTIGATION OF THE IONOSPHERE USING SIGNALS FROM EARTH SATELLITES. E.Woyk(Chvojková).
Nature (London), Vol. 182, 1362-3 (Nov. 15, 1958).

Consideration of possible effects of the ionosphere on 40 Mc/s signals from an artificial satellite. The chief effects discussed are various modes of long-distance propagation around the earth and the occurrence of focusing of radio waves from the point antipodal to the observer.
G.M.Brown

538.566.3 : 523.4

4857. ABSORPTION OF MICROWAVES IN PLANETARY ATMOSPHERES. S.Chandra and B.P.Srivastava.
Z. Astrophys., Vol. 47, No. 2, 127-34 (1959).

The absorption of microwaves in various planetary absorbing gases was calculated. The integrated absorption due to oxygen present in the earth's atmosphere was found to be 0.16, 0.099 and 0.092 dB at $\nu = 1$, 0.33 and 0.1 cm^{-1} respectively. The absorption due to nitrous oxide in Mars and Venus and the absorption due to ammonia in Mars, Venus and Jupiter has also been calculated. The absorption due to earth's ionosphere has been found to be negligible at these frequencies. Total absorption at $\nu = 1$, 0.33 and 0.1 cm^{-1}: earth 0.16, 0.099, 0.092 dB; Mars 0.087, 0.019, 0.002 dB; Venus 0.17, 0.037, 0.003 dB; Jupiter 29.498, 6.374, 0.505 dB. It seems, therefore, that the atmospheres of most of the planets except Jupiter offer negligible attenuation to microwaves.

538.567

4858. MICROWAVE FARADAY ROTATION: DESIGN AND ANALYSIS OF A BIMODAL CAVITY. A.M.Portis and D.Teaney.
J. appl. Phys., Vol. 29, No. 12, 1692-8 (Dec., 1958).

The design and analysis of a bimodal cavity for the observation of microwave Faraday rotation is presented. An equivalent circuit of lumped elements is developed and the coupling between degenerate cavity modes is expressed in terms of the elements of the susceptibility tensor of the material producing the rotation. The theory is checked against experimental results with a paramagnetic salt and substantial agreement is obtained. A cavity of this type when used in conjunction with superheterodyne detection appears to provide a high sensitivity spectrometer for the observation of magnetic resonance.

NUCLEAR AND ATOMIC PHYSICS

APPARATUS . PARTICLE DETECTORS

539.1.07

4859. THE CHOICE OF COUNTING EQUIPMENT. B.H.Parks.
Atomic Energy Res. Establ. (Harwell) Rep. I/R2773, 31 pp. (1958).

The purpose of this report is to provide some assistance to persons not at present actively engaged on atomic energy work, but preparing to start work with radioisotopes, in the selection of radiation detecting and measuring equipment from that currently produced in Britain.

539.1.07

4860. A USEFUL FORMULA FOR CALCULATING THE COUNTING RATE OF A DETECTOR IMMERSED INTO EXTENDED GASES AND LIQUIDS. G.Aniansson and L.G.Erwall.
Internat. J. appl. Radiation and Isotopes, Vol. 2, No. 2, 166 (1957).

The formula, which is theoretically derived, has been used in planning tracer investigations where a knowledge of the counting rate is required as a function of the amount of tracer in a known volume of "solvent". The calculated counting rates were found to be good approximations of those actually obtained.
I.C.Demetsopoullos

539.1.07 : 539.163

4861. CALCULATIONS OF ACTIVITIES DERIVED FROM DECAY DATA AND CORRECTIONS FOR THE RESOLVING TIME OF THE APPARATUS.
D.J.Apers, P.C.Capron, L.J.Gilly and A.Vander Stricht.
Ann. Soc. Sci. Bruxelles I, Vol. 71, No. 3, 214-21 (1957).

An account is given of a modification to a method of deducing activities from integrated numbers of counts over a considerable portion of the decay curve (see P.Capron and E.Crevecoeur, J. Chim. phys., Vol. 49, 29, 1952). The modification takes account of the counter resolving time. The formula is deduced for the case of two activities and results of a measureme is used to illustrate its use.
A.Ashmo

539.1.

4862. $\beta-\gamma$ IONIZATION CHAMBER.
J.J.Engelmann and B.Grinberg.
Internat. J. appl. Radiation and Isotopes, Vol. 5, No. 1, 63-6 (Feb., 1959). In French.

This chamber, which is designed for activity-control of radioactive solutions at the time of utilization, is particularly convenie for medical purposes. Three types of measurement are possible: (1) measurement of specific activity of β-emitter solutions above 50 $\mu c/cm^3$; (2) measurement of γ-emitters – solid or liquid – above 1 mc; (3) dose control at the surface of β-applicators used i betatherapy. The chamber can be used as a standard after calibrating with standard solutions.

539.1.

4863. APPLICATIONS OF LIQUID SCINTILLATION COUNTERS
F.N.Hayes.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 166-70 (Dec., 1958).

A survey of the most notable applications.

539.1.07 : 539.1

4864. APPLICATION OF SCINTILLATION COUNTERS TO REACTORS. W.W.Managan.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 171-7 (Dec., 1958).

Gamma-sensitive scintillators may be applied to low-power training reactors and reactor critical experiments where the residual fission-fragment gamma-activity is kept low. Some results of applying gamma-sensitive scintillators with linear and log-n-perio circuits to reactor critical experiments are compared to results ob tained with conventional neutron sensitive counters and ion chambe Relative performances and reliability are discussed. One advantag found is a reduction in the time required to sense an unsafe condition. Power reactor problems of monitoring for excessive exhau stack gas activity and for fission fragment leakage from defective fuel elements are also discussed.

539.1.C

4865. STUDY OF SOME CONDITIONS OF USE OF LIQUID SCINTILLATORS. A.Coche and G.Laustriat.
J. Phys. Radium, Vol. 19, No. 6, 595-601 (June, 1958). In French.

The variation of the proportion of light reaching the cathode of the photomultiplier has been examined with respect to the shape an the dimensions of the scintillator, and the nature of the coating whi surrounds it. Both the variation of the pulse height, and that of anode current were determined. Certain practical indications on the best conditions to be realised for the detection of nuclear radiations can be deduced from those experiments.

539.1.07 : 535.82

4866. ELECTRONIC PARTICLE LOCATING ATTACHMENT FO MICROSCOPES. F.E.Adley and P.L.Einenacher.
Internat. J. appl. Radiation and Isotopes, Vol. 1, No. 4, 315 (Jan., 195

The condenser substage is replaced by an apertured plate unde which is mounted a scintillation counter. An audible signal occurs when an active particle appears in the aperture.
A.E.I. Research Laborator

539.1.07

4867. USE OF $Li^6I(EU)$ AS A FAST-NEUTRON DETECTOR AND SPECTROMETER. R.B.Murray.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3,159-61 (Dec., 1958).

A review is given of experiments carried out in an investig ation of the scintillation response of $Li^6I(Eu)$ to fast neutrons. A co siderable improvement in fast-neutron resolution is realized by ope ation of the crystal at low temperatures. Pulse-height spectra have been recorded for neutrons from various sources providing both lin spectra and continuous spectra. These experiments indicate possibl applications of $Li^6I(EU)$ as a fast-neutron detector and spectrometer

539.1.07

4868. EFFICIENT LOW-LEVEL COUNTING SYSTEM FOR C^{11}.
J.B.Cumming and R.Hoffmann.
Rev. sci. Instrum., Vol. 29, No. 12, 1104-7 (Dec., 1958).

A low-level counting system used in absolute measurements of the $C^{12}(p,pn)C^{11}$ cross-section is described. In this system small activities of C^{11} produced in polystyrene-based plastic scintillators by irradiation with high-energy protons are detected with high effici ency by 4π scintillation counting. Background reduction is achieved by counting in a shield consisting of 12 in. of iron and 1 in. of mercury and by the use of a ring of Geiger counters in anticoincidence with the scintillation counter. A background of 8 counts per min was obtained for a 1.5-in. diam., 1-in. thick scintillator in which the overall detection efficiency for C^{11} is 90%. Determination of the counting efficiency by a positron-annihilation coincidence method is described and the results of experiments to reduce the background still further are reported. Application of this system to monitoring fluxes of energetic protons and neutrons is discussed.

539.1.07 : 537.533 : 621.383.27

4869 THE RESOLUTION OF PHOTO-MULTIPLIERS IN SCINTILLATION SPECTROMETERS. J.Kopecký and J.Kajfosz.
Czech. J. Phys., Vol. 8, No. 2, 171-80 (1958).

The resolution of scintillation γ-spectrometers is influenced by several factors. A method for separately judging the individual factors is discussed. The influence of statistical processes in the photomultiplier and the possibility of improving the resolution of the scintillation spectrometer by choosing the most suitable photomultiplier and its working parameters is particularly studied.

539.1.07

4870. THE EFFECT OF TEMPERATURE ON PHOTOMULTIPLIERS AND LIQUID SCINTILLATORS.
G.Laustriat and A.Coche.
J. Phys. Radium, Vol. 19, No. 12, 927-9 (Dec., 1958). In French.

The eleven photomultiplier tubes tested (6 Du Mont 6292 and 5 RCA 6342) all give negative temperature coefficients; the scintillators used show a variation of the same kind as the photomultipliers, but less important.

539.1.07 : 535.376

NOBLE ELEMENT SCINTILLATORS. See Abstr. 4475

539.1.07 : 535.376

DECAY TIMES OF ORGANIC SCINTILLATORS AND THEIR APPLICATION TO THE DISCRIMINATION BETWEEN PARTICLES OF DIFFERING SPECIFIC IONIZATION. See Abstr. 4476

539.1.07 : 537.533 : 621.383.27

DESIGN OF PHOTOMULTIPLIERS FOR THE SUB-MILLIMICROSECOND REGION. See Abstr. 4691

539.1.07 : 537.533 : 621.383.27

REVIEW OF 20th CENTURY ELECTRONICS LTD PHOTOMULTIPLIERS. See Abstr. 4694

539.1.07

4871. CERENKOV COUNTERS IN HIGH ENERGY PHYSICS.
C.E.Wiegand.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 77-81 (Dec., 1958).

Emphasis on the practical design of velocity-sensitive devices. The performance and problems associated with three types of detector are considered: simple velocity threshold counters and wide-band and narrow-band velocity selectors. The limitation in resolution of practical velocity-sensitive counters in high energy experiments arises mainly from the characteristics of the beams which must pass through their radiators. These limitations include divergences in the direction of the beam particles, multiple Coulomb scattering, and changes in velocity of particles as they pass through the Cherenkov radiator. Methods of coupling radiators to multiplier phototubes include direct optical contact, specular reflection, and diffuse reflection. Magnesium oxide is an excellent diffuse reflector and methods of its application are given. Statistical fluctuations in the small numbers of photo-electrons produced from Cherenkov radiators limit the accuracy with which the times of passage of individual particles are determined.

539.1.07

4872. A DIFFERENTIAL CERENKOV COUNTER.
D.E.Baldwin, C.Burrowes, D.O.Caldwell, S.G.Hamilton, D.Hill, L.S.Osborne and D.M.Ritson.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 177-8 (Dec., 1958).

A beam of parallel particles of given velocity traversing a transparent radiator gives off Cherenkov radiation at a unique angle with respect to the beam direction independently of the point of traversal. Such light can be brought to a ring focus. A Cherenkov counter has been built using this principle. Velocity definition is obtained by using a ring diaphragm on the face of a photomultiplier. The greatest velocity definition is obtained for small angle Cherenkov light; the chosen angle is 10 degrees. To change the velocity selection without changing the optics the index of refraction of the radiator is varied. The index of refraction may be varied by changing the pressure of a gas near its critical point. The working fluid is Fluorochemical FC-75. The index of refraction of FC-75 can be varied continuously from $n = 1.15$ to $n = 1.01$ at a temperature of 250°C by changing the pressure. The counter has been tested using 1.8 BeV/c π mesons from the Brookhaven Cosmotron; the counting rate versus pressure of the FC-75 has a full width corresponding to less than $\Delta\beta = 0.01$.

539.1.07

4873. ON THE USE OF SECONDARY ELECTRON MULTIPLIERS IN SCINTILLATION APPARATUS. F.Bernhard.
Exper. Tech. der Phys., Vol. 4, No. 4, 160-2 (1956). In German.

The efficiency of the multiplier is the product of (1) the fraction of scintillation quanta collected, (2) the quantum yield of the cathode, and (3) the yield of electrons to the first dynode. The amplification factor and the dark current of the cell are scarcely concerned. Some practical details of design are discussed. S.T.Henderson

539.1.07

4874. DESIGN OF A MEASURING APPARATUS FOR THE 4π COUNTING OF RADIOACTIVE ISOTOPES. G.Krüger.
Exper. Tech. der Phys., Vol. 6, No. 3, 109-14 (1958). In German.

Illustrated description of a 4π methane-flow counter designed for the determination of the absolute rate of disintegration of radio-isotopes which emit at least one corpuscular particle per decay. The counter operates in the interval of limited proportionality and consists primarily of 2 brass hemispheres. The sources of possible errors are discussed. Results of trial tests (Tl^{204}, P^{32}, Co^{60}, C^{14}, U_3O_8; also effect of contamination of CH_4 with varying proportions of air) are presented in the form of relative-rate versus potential graphs. It is claimed that the apparatus can be easily applied to routine measurements. F.Lachman

539.1.07

4875. APPLICATION OF VYNS FILMS IN THE 4π FLOW COUNTER. G.Krüger.
Exper. Tech. der Phys., Vol. 6, No. 3, 114-19 (1958). In German.

Describes a method for preparing this film (which is used for separating the two hemispheres and for supporting the sample under test) from a standard solution by stretching the layer of the solution on the surface of water in a special vessel. Properties of the film are also described. The thickness is evaluated from the interference colours in reflected light. F.Lachman

539.1.07 : 539.16.08

4π β–γ COINCIDENCE APPARATUS FOR RADIO-ISOTOPE STANDARDIZATION. See Abstr. 3844

539.1.07

4876. DOSE-RATE DEPENDENT DOSIMETER FOR LOW-INTENSITY GAMMA-RAY FIELDS.
K.O'Brien, L.R.Solon and W.M.Lowder.
Rev. sci. Instrum., Vol. 29, No. 12, 1097-100 (Dec., 1958).

It was suggested that a NaI(Tl) phosphor be used to amplify densities enough to make a film dosimeter practicable for the low gamma-ray dose rates produced by background radiation. This use is complicated by the dependence of film density on dose rate as well as dose. An analysis of the process provides a correction for the dose-rate dependence when the dose rate is constant. The magnitude of the error involved in assuming the dose-rate constant when it is a function of time is evaluated.

539.1.07 : 539.12

CLOUD CHAMBERS FOR SUB-ELECTRON CHARGE MEASUREMENTS. See Abstr. 3714

539.1.07

4877. ALPHA AND PROTON DISCRIMINATION IN D_1 AND K_0 PHOTOGRAPHIC EMULSIONS. M.Ader and M.P.Cabannes.
J. Phys. Radium, Vol. 19, No. 12, 939-42 (Dec., 1958). In French.

Methods are given for intensifying the trajectories of α-particles and protons in Ilford D_1 and K_0 emulsions. These methods enable one to distinguish satisfactorily one kind of particle from the other, and to count easily grains and gaps in proton and α-particle tracks.

539.1.07 : 621.374.32

4878. MULTICHANNEL SPECTROMETER DETECTOR.
H.W.Kendall.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 190-4 (Dec., 1958).

The use of a multichannel detector in the focal plane of a magnetic spectrometer effectively decouples the well-known reciprocal relation between spectrometer resolution and transmission applicable to single-channel detection. The Stanford 36 in. magnetic spectrometer is used in electron-scattering experiments in conjunction with the Mark III linear electron accelerator. In order to utilize the full momentum acceptance of the spectrometer ($\Delta p/p \cong 0.05$), a

10-channel prototype of a 50-channel scintillation—Cherenkov detection system has been constructed, which will posses a resolution ($p/\Delta p \cong 1000$) close to the maximum obtainable from the spectrometer. The momentum channels are defined by small scintillation counters which detect ionizing particles, consisting primarily of high-energy pions and electrons. Electrons are distinguished from mesons by Cherenkov counters which back up blocks of 10 scintillators. A coincidence is required ($2\tau \cong 3 \times 10^{-8}\ \mu$sec) between a scintillation detector and the associated Cherenkov counter. A 256-channel computer type ferrite core memory (Radiation Counter Laboratories Mark 20), divided into four manually or electronically-selected blocks of 64 channels, is used to store the information from the counter array. The use of this large memory allows storage of correlated information in matrix form from two arrays of counters.

539.1.07 : 530.162

STOCHASTIC THEORY OF COUNTERS WITH DEAD TIME. See Abstr. 4303

539.1.07

4879. A HIGH RESOLUTION FLAT CRYSTAL SPECTROMETER FOR NEUTRON CAPTURE γ-RAY STUDIES. J.W.Knowles.
Canad. J. Phys., Vol. 37, No. 2, 203-31 (Feb., 1959).

A flat crystal diffraction spectrometer, constructed for the measurement of γ-rays resulting from neutron capture, is discussed both experimentally and theoretically. The spectrometer is used either as a single crystal or a double crystal instrument. In the single crystal arrangement a Laue diffracted γ-ray beam from a broad source proceeds through a Soller slit which gives it a 45-second angular divergence, to a sodium iodide scintillation detector. The energy is determined by the angle between the Soller slit and the crystal. The resolution is determined by the Soller slit, and is 4% at 1 MeV when diffracting from the (440) planes of a single germanium crystal. In the two-crystal configuration a γ-ray which is Laue diffracted from the first crystal is further diffracted from a second crystal set in the antiparallel position. The angle between the reflecting planes of the two crystals determines the γ-ray energy. The Soller slit serves only as shielding for the detector in this arrangement. The resolution depends upon the mosaics and thicknesses of the crystals; it is 0.4% at 1 MeV for diffraction from the (211) planes of two calcite crystals, each 23 mm thick and of 1.7- and 0.9-second mosaics respectively. The range of measurement extends from 80 keV to greater than 5 MeV. Where other values of γ-ray energies exist, agreement to within the expected precision, ±0.2% is obtained. The counting efficiency as a function of energy depends on the integrated reflectivities of the crystals which may be determined at the time of a γ-ray measurement by means of the double crystal arrangement. The integrated reflectivity as a function of energy was calculated for a number of crystals of known mosaic and throughout the range of measurement, from 0.2 to 5 MeV, good agreement is obtained.

539.1.07 : 537.531

4880. RESPONSE FUNCTIONS OF TOTAL-ABSORPTION SPECTROMETERS. H.W.Koch and J.M.Wyckoff.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 127-37 (Dec., 1958).

The characteristic shapes of the response functions of a sodium iodide scintillation spectrometer determine the potential of the spectrometer for X- or gamma-ray spectroscopy. The present report reviews the evaluation of these functions for monoenergetic X-rays and the limitations placed by this evaluation on the quality of the results for various applications. Emphasis is given to theoretical and experimental methods at X-ray energies between 1 and 100 MeV. The theoretical methods available up to 4.5 MeV are either of the analytical or Monte Carlo types. Above 4.5 MeV, no satisfactory theoretical approaches have been developed. Experimental methods using gamma-ray sources, monoenergetic electron data to synthesize X-ray responses, and synchrotron bremsstrahlung are reviewed in detail.

539.1.07

4881. A SODIUM IODIDE (T1) TOTAL ABSORPTION SPECTROMETER FOR HIGH ENERGIES. A.W.Knudsen and R.Hofstadter.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 151-4 (Dec., 1958).

A scintillation counter employing a 70 lb NaI(T1) crystal and a Swiss (AfiF) multiplier phototube was tested with electrons of energy up to 600 MeV. The plot of pulse height v. energy of incident electrons is found to be linear up to the highest energy tested (600 MeV). Energy resolution of 16 per cent has been obtained at 350 MeV. The crystal is 9 in. both in diameter and length. The incident radiation, which can be either electrons or gamma rays, induces a cascade electromagnetic shower within the mass of the crystal giving rise to light which enters the photomultiplier tube. Graphs showing linearity in energy response are presented as well as plots of line shape at constant energy of the incident particle. The procedure for obtaini line breadth semi-theoretically is described, and the breadth so derived compared with the value obtained in actual practice. Detai of the airtight crystal enclosure and of the crystal-photomultiplier optical coupling system are shown.

539.1.07 : 545

4882. A HIGH STABILITY GAMMA-RAY SPECTROMETER FOR USE AT HIGH COUNTING RATES. W.B.Nelligan and J.Tittman.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 187-90 (Dec., 1958).

A spectrometer has been developed for rapid quantitative dete mination of nitrogen content in bulk media using neutron-capture gamma-ray analysis. Four NaI(Tl) scintillation detectors, each operated at counting rates of the order of 10^5 per sec, are utilized permit rapid measurement. Resolution loss due to pile-up minimiz by the use of a 40 mμ sec pulse-width at the photomultiplier anode followed directly by a low level biased silicon diode preselector. Those portions of pulses exceeding the diode bias are stretched and the four stretcher outputs are fed to a common amplifier of the no overloading type which has been modified to improve stability. The preselector reduces by almost two orders of magnitude the effectiv pulse rate which must be handled by the amplifier. Since pulse-height stability requirements are stringent, temperature regulation the scintillation detectors and preselector units is used. Detailed measurements indicate that the NaI crystal—photomultiplier combination contributes more instability than all the other spectromete components combined.

539.1.07 : 539.16

LONG-LENS MAGNETIC BETA-RAY SPECTROMETER. See Abstr. 3857

539.1.07 : 537.534.3

MAGNETIC ION-BEAM SPECTROMETERS. See Abstr. 4723-6

ELEMENTARY PARTICLES

539.12 : 537.312.62 : 536.48

RECENT ADVANCES IN THE PHYSICS OF ELEMENTARY PARTICLES. See Abstr. 4523

539.12

4883. ON THE SYMMETRY OF ELEMENTARY PARTICLES. A.O.Barut.
Nuovo Cimento, Vol. 10, No. 6, 1146-7 (Dec. 16, 1958).

Suggests a three-dimensional diagram to represent the Gell-Mann—Nishijima elementary particle scheme. R.J.N.Phillips

539.12 : 530.162

STATISTICAL ANALYSIS ARISING FROM THE PHYSICS OF MICROCORPUSCLES. POISSON DISTRIBUTIONS OF RELATIVE MEASUREMENTS. See Abstr. 4302

539.12 : 539.17

ATTENUATION OF γ-RAYS FROM AN INFINITE PLANE. CORRECTIONS TO DATA SHEET NO. 25. See Abstr. 3913

539.12

4884. EXPERIMENT MADE TO DEMONSTRATE THE DELBRÜC EFFECT IN THE ELASTIC SCATTERING OF 2.62 MeV PHOTONS. P.Eberhard, L.Goldzahl and E.Hara.
J. Phys. Radium, Vol. 19, No. 7, 658-67 (July, 1958). In French.

Elastic scattering measurements were made for γ-rays in orde to find a proof of Delbrück scattering. Measurements are described for 2.62 MeV γ-rays from Th C'' and scatterers of lead, bismuth and uranium. The cross-sections of elastic scattering have been found with an accuracy 15-20%.

539.12

4885. ELASTIC SCATTERING OF 1.33 MeV AND 1.17 MeV Co^{60} γ-RAYS, AND 1.12 MeV Zn^{65} γ-RAYS, BY LEAD AND TIN. E.Hara, J.Banaigs, P.Eberhard, L.Goldzahl and J.Mey.
J. Phys. Radium, Vol. 19, No. 7, 668-73 (July, 1958). In French.

The total elastic scattering was measured and compared with new theoretical calculations. No effect of Delbrück scattering was found, but an inelastic scattering appeared, which had previously been neglected.

539.12

4886. CONTRIBUTION OF THE IMAGINARY PART OF THE AMPLITUDE OF THE DELBRUCK EFFECT TO THE ELASTIC SCATTERING OF PHOTONS. P.Kessler.
J. Phys. Radium, Vol. 19, No. 10, 739-44 (Oct., 1958). In French.

An expression is obtained for the imaginary part of the amplitude of the Delbruck effect (elastic scattering of a photon by the electric field of nuclei). This expression is given in the form of two five-fold integrals, corresponding to the two possible polarization states of the photon. An approximate calculation of these integrals is made for a photon energy of 2.62 MeV and four different values of the scattering angle, using an IBM 650 computing machine.

539.12

4887. ENERGY DISTRIBUTION OF GAMMA-RAYS PENETRATING THICK BARRIERS. I. K.A.Mahmoud.
Proc. Math. Phys. Soc. Egypt, No. 21, 41-55 (May, 1957).

A scintillation spectrometer was employed to observe the changes in the spectrum of gamma-radiation from monochromatic isotropic point sources, after transmission through large sheets of various thickness of carbon, iron, lead, water and concrete. The sources used were Au^{198}, Cs^{137}, Co^{60} and Na^{24}.

539.12

4888. ENERGY DISTRIBUTION OF GAMMA-RAYS PENETRATING THICK BARRIERS. II. K.A.Mahmoud.
Proc. Math. Phys. Soc. Egypt, No. 21, 57-62 (May, 1957).

Within the limitations set by the experimental arrangements, reasonable agreement with the theoretical predictions of the energy distribution, based on the known scattering phenomena of gamma-ray energies, were observed.

539.12

4889. SELF-ENERGY OF THE LONGITUDINAL NEUTRINO. W.W.Wada.
Nuovo Cimento, Vol. 10, No. 4, 728-9 (Nov. 16, 1958).

It is verified that the neutrino self-energy, calculated in lowest-order perturbation theory, vanishes if the neutrino, whose "bare" mass is taken as zero, is in an eigenstate of γ_5. P.K.Kabir

539.12

4890. FREE ANTINEUTRINO ABSORPTION CROSS SECTION. I. MEASUREMENT OF THE FREE ANTINEUTRINO ABSORPTION CROSS SECTION BY PROTONS. F.Reines and C.L.Cowan, Jr.
Phys. Rev., Vol. 113, No. 1, 273-9 (Jan. 1, 1959).

The cross-section for the reaction $p(\bar{\nu},\beta^+)n$ was measured using antineutrinos ($\bar{\nu}$) from a powerful fission reactor at the Savannah River Plant of the United States Atomic Energy Commission. Target protons were provided by a 1.4×10^3 litre liquid scintillation detector in which the scintillator solution (triethylbenzene, terphyenyl, and POPOP) was loaded with a cadmium compound (cadmium octoate) to allow the detection of the reaction by means of the delayed coincidence technique. The first pulse of the pair was caused by the slowing down and annihilation of the positron (β^+), the second by the capture of the neutron (n) in cadmium following its moderation by the scintillator protons. A second giant scintillation detector without cadmium loading was used above the first to provide an anticoincidence signal against events induced by cosmic rays. The antineutrino signal was related to the reactor by means of runs taken while the reactor was on and off. Reactor radiations other than antineutrinos were ruled out as the cause of the signal by a differential shielding experiment. The signal rate was 36 ± 4 events/hr and the signal-to-noise ratio was $\frac{1}{5}$, where half the noise was correlated and cosmic-ray associated and about half was due to non-reactor-associated accidental coincidences. The cross-section per fission $\bar{\nu}$ (assuming 6.1 $\bar{\nu}$ per fission) for the inverse beta decay of the proton was measured to be $(11 \pm 2.6) \times 10^{-44}$ $cm^2/\bar{\nu}$ or $(6.7 \pm 1.5) \times 10^{-43}$ cm^2/fission. These values are consistent with prediction based on the two-component theory of the neutrino.

539.12 : 539.17

4891. FREE ANTINEUTRINO ABSORPTION CROSS SECTION. II. EXPECTED CROSS SECTION FROM MEASUREMENTS OF FISSION FRAGMENT ELECTRON SPECTRUM.
R.E.Carter, F.Reines, J.J.Wagner and M.E.Wyman.
Phys. Rev., Vol. 113, No. 1, 280-6 (Jan. 1, 1959).

A measurement of the electron spectrum from the thermal neutron fission of U^{235} is described. From this spectrum the antineutrino spectrum is calculated, and on the basis of the two-component theory of the antineutrino a predicted average cross-section for the absorption of antineutrinos by protons is $(6.1 \pm 1) \times 10^{-43}$ cm^2/fission. This agrees with the measured cross-section of $(6.7 \pm 1.5) \times 10^{-43}$ cm^2/fission. The four-component theory of the antineutrino would have predicted $(3.05 \pm 0.5) \times 10^{-43}$ cm^2/fission.

539.12

4892. MODIFIED HELICAL METHOD FOR DETERMINING e/m. B.L.Miller.
Amer. J. Phys., Vol. 27, No. 4, 256-9 (April, 1959).

In the helical method a cathode-ray tube is inserted in a solenoid and e/m determined from the condition for focusing deflected electrons to a spot on the screen. This was modified by substituting alternating current in the solenoid and simultaneously supplying a voltage to the deflection plates proportional to the solenoid current. As a result, all electrons move in spirals of the same radius and the pattern observed is a portion of a circle (provided the beam has been properly centred). By adjusting the solenoid current until a full circle just appears, e/m may be deduced. The results obtained were consistent with those of the method using direct current, but were 6 to 9% low. The discrepancy was traced to using the distance from the screen to the rear of the deflection plates in the e/m formula, whereas an analysis showed it should be measured to the centre of the plates. e/m was also obtained from the magnitude of the radius of the displayed circle.

539.12

4893. DIRECT PAIR-PRODUCTION BY ELECTRONS. G. Lütjens.
Z. Naturforsch., Vol. 13a, No. 7, 510-14 (July, 1958). In German.

In observations on 63.2 metres of electron track in Ilford G5 emulsion exposed to a beam of 800 ± 50 MeV electrons, 57 events were found in which trident production could be assumed. Of these, 42 tridents were used to obtain the mean free path and the cross-sections for multiple Coulomb scattering: $\lambda = 140^{+36}_{-23}$ cm; $\sigma_{tot}(800\ \text{MeV}) = (0.89 \pm 0.18) \times 10^{-25}\ \text{cm}^2$. Comparison of the results with the theory of Bhabha gave satisfactory agreement. S.J.St-Lorant

539.12 : 537.533.74

4894. ABSOLUTE ELECTRON-NUCLEAR DIFFERENTIAL SCATTERING CROSS SECTIONS AT 1.00 MeV, 1.75 MeV, AND 2.50 MeV. I.
V.Speigel, Jr, T.F.Ruane, D.J.Anthony, B.Waldman and W.C.Miller.
Ann. Phys. (New York), Vol. 6, No. 1, 70-85 (Jan., 1959).

Monoergic electrons were scattered from thin foils of aluminium, nickel, silver, and gold. The scattered electrons were analysed by a 90° magnetic spectrometer using a scintillation detector. The absolute cross-sections were measured at 30° with an estimated error of 3%, at 60° and 90° with an estimated error of 2%, and at 120° and 150° with an estimated error of 5%. The experimental results were 5% to 10% lower than the values predicted by the Mott theory as evaluated by Doggett and Spencer. When the theory is corrected for the effect of nuclear size and the radiative correction of Schwinger an improved fit results. However, the discrepancy between the corrected Mott theory and the measured cross-sections is well outside the experimental error.

539.12 : 537.533.74

4895. PLURAL SCATTERING OF ELECTRONS AT 1.00 MeV, 1.75 MeV, AND 2.50 MeV. II.
V.Speigel, Jr, W.C.Miller and B.Waldman.
Ann. Phys. (New York), Vol. 6, No. 1, 86-9 (Jan., 1959).

Monoergic electrons were scattered from thin foils of aluminium, nickel, silver and gold. The scattered electrons were analysed by a magnetic spectrometer. The electron—nuclear cross-sections were measured as a function of foil thickness and for scattering angles of 30°, 60°, 90°, 120°, and 150°. The data presented show the onset of plural scattering and may be used as a convenient guide for single scattering.

539.12 : 537.533.74

4896. ABSOLUTE ELECTRON—ELECTRON DIFFERENTIAL SCATTERING CROSS SECTIONS AT 1.00 MeV, 1.50 MeV, AND 2.00 MeV. III. J.J.Kepes, B.Waldman and W.C.Miller.
Ann. Phys. (New York), Vol. 6, No. 1, 90-101 (Jan., 1959).

Monoergic electrons were scattered from thin Zapon and Nylon foils. The scattered electrons were observed at 30° in the laboratory system (~ 90° c.m.) were analysed by a magnetic spectrometer. The absolute electron—electron scattering cross-sections agree with the theory of Møller to within the experimental error of 4%. The broadening of the momentum distribution of the scattered electrons was in reasonable agreement with the theory of Ford and Mullin. The conservation laws for relativistic particles were experimentally verified to an accuracy of 1%.

539.12

4897. BACK-SCATTERING OF β-RAYS IN MATTER. A.Hettler.
J. Phys. Radium, Vol. 19, No. 12, 923-6 (Dec., 1958). In French.

A survey of various influencing factors, such as: atomic number of the support, the thickness and average atomic number of the source.

539.12

4898. ELECTRON—DEUTERON SCATTERING BY THE IMPULSE APPROXIMATION. A.Goldberg.
Phys. Rev., Vol. 112, No. 2, 618-22 (Oct. 15, 1958).

The cross-section for inelastic scattering of high-energy electrons by deuterons is calculated using the impulse approximation. The results agree with those of Jankus (Abstr. 6146/1956). The cross-sections are given for several neutron charge and moment distributions. The peak cross-sections are simply related to the free-nucleon cross-sections with this approximation.

539.12

4899. RADIATIVE CORRECTIONS FOR NEARLY ELASTIC SCATTERING. E.L.Lomon.
Phys. Rev., Vol. 113, No. 2, 726-7 (Jan. 15, 1959).

The treatment of large infrared contributions to electron scattering is discussed. An expression is given for any energy resolution, yielding a previously conjectured form in the limit of perfect resolution.

539.12

4900. HIGHER ELECTROMAGNETIC CORRECTIONS TO ELECTRON—PROTON SCATTERING. S.D.Drell and S.Fubini.
Phys. Rev., Vol. 113, No. 2, 741-4 (Jan. 15, 1959).

Higher order electromagnetic corrections to the electron—proton scattering amplitudes are studied. The scattering amplitude is subjected to a dispersion analysis which permits the e^4 contribution to be written as the sum of two terms. The first corresponds to radiative corrections to the form factors, the second to virtual photon Compton scattering by the proton. A simple model is constructed for the resonant contribution to Compton scattering which is shown to correct the form factor analysis neglibibly up to ~1 BeV for all scattering angles.

539.12

4901. THE ENERGY—RANGE RELATION FOR MONO-ENERGETIC FAST ELECTRONS. H.Breuer, D.Harder and W.Pohlit.
Z. Naturforsch., Vol. 13a, No. 7, 567-8 (July, 1958). In German.

A 35 MeV betatron was used for the measurements. The electron energy was calibrated in terms of the (γ,n) reaction in Cn^{63}, O^{16} and C^{12}. Results are given for an aluminium target.
A.E.I. Research Laboratory

539.12

4902. POLARIZATION PHENOMENA IN PHOTOELECTRIC EFFECT AND ONE QUANTUM ANNIHILATION OF POSITRONS IN THE K-SHELL. H.Banerjee.
Nuovo Cimento, Vol. 11, No. 2, 220-8 (Jan. 16, 1959).

Polarization effects in the cross-sections for both the photoelectric and the positron annihilation processes in the K-shell have been investigated by the Stokes parameter method for arbitrary polarization of the incident particles. The scattering states of the electron and the positron have been approximated by Sommerfeld—Maue wave-functions. Results have been obtained correctly up to terms of O(a) and neglecting terms of $O(a/\epsilon)$, where $a = Z/137$ and ϵ is the energy of the scattering state in units of mc^2. It has been found for either case that in the first approximation there is correlation only between the circular polarization of the photon and the component of the polarization vector of the free Dirac particle in the plane of scattering. In the high energy limit, the ratio of the degree of circular polarization of the incident (emitted) radiation and the degree of longitudinal polarization of the photoelectron (positron) tends to unity.

539.12

4903. QUENCHING OF POSITRONIUM LIFETIMES BY MOLECULAR IODINE. C.R.Hatcher and W.E.Millett.
Phys. Rev., Vol. 112, No. 6, 1924-6 (Dec. 15, 1958).

Measurements of the mean life of the τ_2 component for decay in solutions of iodine in normal heptane give a value of 10^{-17} cm^2 for the cross-section of molecular iodine for annihilating ^3S positronium on collision. This effect is attributed to an enhancement of "pickoff" annihilation resulting from either a tendency to form positronium iodide or the high polarizability of molecular iodine. In quenching τ_2 from 2.49×10^{-9} sec to 1.32×10^{-9} sec the intensity I_2 of the long component was observed to vary over a range from 40% to 27%; however, the errors in I_2 are so large for the shorter lifetimes that it is impossible to tell from the data whether or not I_2 is influenced by the presence of iodine.

539.1

4904. NEUTRON—PROTON MASS DIFFERENCE BY DISPERSIO THEORY. M.Cini, E.Ferrari and R.Gatto.
Phys. Rev. Letters, Vol. 2, No. 1, 7-9 (Jan. 1, 1959).

The mass difference is calculated using a Compton scattering dispersion relation and retaining only the one-nucleon contribution to the dispersion integral. The correct sign of the mass difference cannot be obtained by inserting, for the nucleon electromagnetic form factors, an extrapolation of electron scattering results: important contributions at higher energies would be required.
J.C.Taylo

539.1

4905. CROSS-SECTION AND POLARIZATION IN ELASTIC NUCLEON—DEUTERON SCATTERING. L.Castillejo and L.S.Singh
Nuovo Cimento, Vol. 11, No. 1, 131-5 (Jan. 1, 1959).

The cross-section and nucleon polarization are calculated from nucleon—nucleon phase-shifts by the impulse approximation assum an S-state deuteron and ignoring multiple scatting, at energies between 40 and 300 MeV. It had been hoped this would decide between various proposed sets of phase shifts, but all those considered give reasonable approximations to experiment. See also following abstract.
R.J.N.Phillip

539.1

4906. TRIPLE-SCATTERING PARAMETERS IN ELASTIC NUCLEON—DEUTERON SCATTERING.
L.Castillejo and L.S.Singh.
Nuovo Cimento, Vol. 11, No. 1, 136-8 (Jan. 1, 1959).

See preceding abstract. The calculations are extended to the change in polarization of initially polarized nucleons. No experiments have yet been performed.
R.J.N.Phillip

539.12

4907. NUCLEON—ANTINUCLEON SCATTERING.
J.S.Ball and J.R.Fulco.
Phys. Rev., Vol. 113, No. 2, 647-50 (Jan. 15, 1959).

By use of the model of the nucleon—antinucleon interaction proposed by Ball and Chew, a calculation of the complex phase-shift at 50 and 260 MeV has been made. The values of annihilation, elasti scattering, and charge-exchange cross-sections, and the angular distributions for p—p and p—n elastic scattering are obtained. A comparison with the experimental data shows reasonable agreement. Finally, the parameters of an optical-model potential for antinucleo interaction with complex nuclei are presented.

539.12 : 537.56

4908. ENERGY LOSS PER ION PAIR FOR PROTONS IN VARIOUS GASES. H.V.Larson.
Phys. Rev., Vol. 112, No. 6, 1927-8 (Dec. 15, 1958).

Values of w for protons in A, N_2, CO_2, dry air, and "tissue-equivalent" gas were measured as 26.66 ± 0.26, 36.68 ± 0.34, 34.37 ± 0.33, 35.18 ± 0.42, and 30.03 ± 0.29 eV/ion pair, respective A 2 MeV positive-ion accelerator was used as the source of protons The energy of the protons was determined with a precision gaussmeter that was calibrated by the Li(p,n) and T(p,n) threshold reactions. These protons were scattered from a gold foil into a parallel plate ionization chamber. The fast-electron pulses were collected on one electrode, amplified, and counted. The positive-ion charge was collected on the other electrode and measured by means of a standard capacitor that was connected between the input and feedbac terminals of a vibrating-reed electrometer.

539.12

4909. COMPARISON OF THE METHODS FOR MASS DETERMINATION BASED ON THE RANGE—IONISATION MEASUREMENT. B.Dobovišek.
"J. Stefan" Inst. Rep., Vol. 2, 39-45 (May, 1955).

The accuracy of mass determination has been studied by measuring the gap density, gap length and photoelectric density, for protons and a K-particle ending in a nuclear emulsion. It is shown that although the quantities are measured with different accuracy, the final error in the mass determination is about the sam for all three methods.
C.J.Batty

539.12

4910. PROTON—PROTON SCATTERING AT 19.8 MeV.
J.W.Burkig, J.R.Richardson and G.E.Schrank.
Phys. Rev., Vol. 113, No. 1, 290-3 (Jan. 1, 1959).

The angular distribution of the scattering of 19.8 MeV protons by protons was measured. The scattering material was hydrogen gas and detection was by scintillation counters. The cross-section as a function of centre-of-mass scattering angle reveals a minimum at 26° where $d\sigma/d\omega = 22.6 \pm 0.3$ mb/steradian. The measurements range from 14° where $d\sigma/d\omega = 59.7 \pm 2.0$ mb/steradian to 90° where $d\sigma/d\omega = 24.6 \pm 0.3$ mb/steradian and include measurements at 15 angles. The phase-shift analysis of the data is as yet incomplete.

539.12

4911. SMALL-ANGLE PROTON-PROTON SCATTERING AT 20 MeV. H.N.Royden and B.T.Wright.
Phys. Rev., Vol. 113, No. 1, 294-6 (Jan. 1, 1959).

The differential cross-section for the scattering of 19.8 MeV protons by protons has been measured for angles between 18° and 35° in the centre-of-mass system, detection being by photographic emulsion placed in a scattering camera. Cross-sections were measured simultaneously at all angles and azimuths. A run with analysing slits closed served to evaluate the small slit-edge correction. The accuracy of the cross-section measurements is approximately 2.5% at all angles except 18°, where the accuracy is about 3%.

539.12

4912. ELASTIC PROTON–PROTON COLLISIONS AT 6.2 BeV IN NUCLEAR EMULSIONS. R.M.Kalbach, J.J.Lord and C.H.Tsao.
Phys. Rev., Vol. 113, No. 1, 325-9 (Jan. 1, 1959).

Ilford G-5 emulsions were exposed to the 6.2 BeV proton beam of the Berkeley Bevatron. Of the interactions located, 31 could be classified as elastic collisions of beam protons with free, hydrogen nuclei. After correction for scanning efficiency and background events, an elastic scattering cross-section of 8.8 ± 2.0 mb was obtained. The centre-of-mass system angular distribution of elastically scattered protons is sharply peaked in the forward and backward direction and is in fair agreement with the prediction of a uniform optical model with a radius of 0.94×10^{-13} cm, a phase shift of 0.00 radian, and an opacity of 0.81. The results are compared with those of previous experiments.

539.12

4913. INELASTIC PROTON–PROTON COLLISIONS AT 6.2 BeV. R.M.Kalbach, J.J.Lord and C.H.Tsao.
Phys. Rev., Vol. 113, No. 1, 330-7 (Jan. 1, 1959).

Inelastic, 6.2 BeV proton-proton collisions in nuclear emulsions were examined using the internal beam of the Berkeley Bevatron. Multiple scattering, grain density, range, and angle measurements yielded the momentum spectra and angular distributions of secondary pions and protons together with the cross- sections for accessible final states. The results indicate a cross-section of 7.3 ± 4.6 mb for two prong events, 12.1 ± 2.4 mb for four prong events, 2.7 ± 0.6 mb for six prong events, 0.3 ± 0.3 mb for eight prong events, and 0.2 ± 0.2 mb for ten prong events, giving a total inelastic cross-section of 22.6 ± 5.3 mb. The average charged pion multiplicity was found to be 1.9 ± 0.3 and the value of K, the average degree of inelasticity, 0.49 ± 0.05. Comparison of observed partial inelastic cross-sections with the predictions of the Fermi statistical theory indicates that this theory underestimates the relative probability for states with high meson multiplicity. Considerable forward and backward peaking was observed in the centre-of-mass system angular distributions for secondary protons, and to a lesser extent, for secondary charged pions. Centre-of-mass system momentum distributions for secondary charged pions peak at lower momenta than predicted by the statistical theory, while those for protons peak somewhat higher than predicted. Effects are discussed which could account for these discrepancies.

539.12 : 539.17

PROTON DISTRIBUTIONS FROM $S^{32}(n,p)P^{32}$. See Abstr. 3922

539.12

4914. STRUCTURE OF THE NEUTRON. K.Tanaka.
Phys. Rev., Vol. 113, No. 2, 714-25 (Jan. 15, 1959).

In an earlier paper (Abstr. 2785/1958) the contribution of the meson current to the electromagnetic structure of the nucleon was calculated by use of the dispersion relations for pion—nucleon scattering. Here the contribution of the nucleon current to the electromagnetic structure of the neutron is obtained analogously by use of the dispersion relations for neutron—proton scattering. Only the contribution from the one-pion and two-pion states of nucleon—nucleon scattering is considered. It is found that both states reduce the neutron—electron potential, i.e., leads to a smaller charge radius of the neutron. The contribution from the deuteron state is shown to be negligible. The resulting mean-square radii of the neutron, including the contributions of both meson and nucleon current, are $(0.23 \times 10^{-13}\text{cm})^2$ for the charge distribution and $(0.41 \times 10^{-13}\text{cm})^2$ for the magnetic moment distribution with $f^2 = 0.08$.

539.12

4915. SCATTERING OF LOW-ENERGY NEUTRONS BY DEUTERONS. L.Sartori and S.I.Rubinow.
Phys. Rev., Vol. 112, No. 1, 214-25 (Oct. 1, 1958).

Neutron—deuteron scattering lengths are calculated by a new variational method which makes provision for polarization (space distortion) of the deuteron. Central Gaussian potentials are employed to represent the two-body interaction, and the trial function is also Gaussian in nature. The results indicate that polarization is not important in either spin state, except for that which is automatically provided by the exclusion principle. The calculated scattering lengths are not in good agreement with either of the two experimentally allowed sets.

539.12 : 530.162

4916. STUDIES OF THE SPHERICAL HARMONICS METHOD IN NEUTRON TRANSPORT THEORY. W.Kofink.
Nuovo Cimento Suppl., Vol. 9, No. 2, 497-541 (1958).

The differences between the Gauss quadrature method and the spherical harmonics method of solving the monoenergetic neutron transport equation are discussed. The Milne problem with p-wave scattering is taken as an example. G.Stephenson

539.12

4917. THE DIFFUSION OF NEUTRONS IN MODERATING AND MULTIPLYING MEDIA WITH A PERIODIC NEUTRON SOURCE. G.Jacob.
An. Acad. Brasil. Cienc., Vol. 30, No. 3, 295-8 (1958).
In Portuguese.

A periodic point source of fast neutrons, producing either triangular, or rectangular, or half-wave pulses is considered in a medium either spherical, or cylindrical, or in the shape of a parallelepiped. The calculation is carried out by the symbolic method of Gallone, Orsoni and Salvetti (Abstr. 3009/1952). L.Pincherle

539.12 : 539.17

NEUTRON DIFFRACTION AT A HIGH-FLUX REACTOR. See Abstr. 3938

539.12 : 614.898

4918. NEUTRON ATTENUATION IN CONCRETE. K.T.Spinney.
Atomic Energy Res. Establ. (Harwell) Rep. T/R 2507, 8 pp. (1958).

The observed behaviour of the penetrating neutrons in a concrete shield is accounted for by a simple theory making use of a calculated "transport" cross-section for fast neutrons. This method is then linked with conventional age theory in an empirical manner so that a good fit is obtained to the observed neutron attenuation at all distances in the shield.

539.12

4919. NEUTRONS FROM (α, n) SOURCES. W.N.Hess.
Ann. Phys. (New York), Vol. 6, No. 2, 115-33 (Feb., 1959).

The neutron energy spectra and yields for several (α, n) neutron sources are calculated and compared with experimental values.

539.12 : 539.17

NEUTRON MULTIPLICATION IN SMALL SPHERES OF FISSIONABLE MATERIAL. See Abstr. 3933

539.12

4920. EVIDENCE AGAINST THE MASS-500 PARTICLE. E.Bierman, R.Lea, J.Orear and S.Rosendorff.
Phys. Rev., Vol. 113, No. 2, 710-12 (Jan. 15, 1959).

The existence of mass-500 particle was investigated by exposing a nuclear emulsion to cosmic rays at an altitude of 10 600 feet and geomagnetic latitude 39°. Particles of average range, 60 g/cm^2 copper, were stopped in the emulsion and grain counted at a residual range of 1 cm. The available track length was such that the existence of a mass-500 particle would have been established on the basis of a single occurrence. About 1100 muons were found with no particles in the region of 500 electron masses being observed. This is not consistent with the abundance reported by Alikhanian et al., (see Abstr. 3411/1957) since the probability of finding none, assuming their reported abundance, is 0.4%.

539.12

4921. RADIATIVE MESON—NUCLEON SCATTERING. II. R.E.Cutkosky.
Phys. Rev., Vol. 113, No. 2, 727-31 (Jan. 15, 1959).

A discussion is given of the corrections which must be made to the results of a previous calculation (see Abstr. 2140/1958) of radiative meson–nucleon scattering, in which the fixed-source model was used. Curves are given which show the spectrum and angular distribution of gamma-rays emitted when positive mesons of energies 130 MeV, 175 MeV, and 220 MeV are scattered by protons.

539.12

4922. RADIATIVE CORRECTIONS TO MUON AND NEUTRON DECAY.

S.M.Berman.

Phys. Rev., Vol. 112, No. 1, 267-70 (Oct. 1, 1958).

The corrections to muon decay due to electromagnetic interactions were recalculated. The results differ from those of Behrends, Finkelstein, and Sirlin (Abstr. 908/1956), because they used an inconsistent method for handling the infrared divergences which arise separately in the real and virtual processes. The disagreement is especially significant near the end of the electron (positron) spectrum where the present results indicate that the radiative correction to the Michel ρ parameter is approximately 1% larger than previously supposed, a result in the direction of increasing agreement between experiment and theory. With the radiative corrections to muon decay given here, the predicted value of the muon lifetime using the universal theory is $(2.27 \pm 0.04) \times 10^{-6}$ sec. As a preliminary to studying the decay of particles with structure, the β decay of the neutron is examined. This leads to an increase in the Coulomb F factor independent of the nuclear charge and of amount approximately 2.6%. As a result the universal coupling constant obtained from the decay of O^{14} is decreased to $G = (1.37 \pm 0.02) \times 10^{-49}$ erg cm^3 and increases the value of the muon lifetime to $(2.33 \pm 0.05) \times 10^{-6}$ sec.

539.12

4923. PRELIMINARY RESULTS ON THE MOMENTUM DEPENDENCE OF THE ASYMMETRY IN MUON DECAY.

H.Kruger and K.M.Crowe.

Phys. Rev., Vol. 113, No. 1, 341-3 (Jan. 1, 1959).

Positive muons from the Berkeley 184 in. synchrocyclotron were stopped in various materials and the asymmetry of positrons from their decay was determined by using a magnetic spectrometer method. The measurements of the polarization are in agreement with that predicted by the two-component neutrino theory. The product of the muon beam polarization and of ξ, the parameter of the two-component neutrino theory, was measured as 0.89 ± 0.09.

539.12

4924. μ-MESON DECAY WITH INNER BREMSSTRAHLUNG.

C.Fronsdal and H.Überall.

Phys. Rev., Vol. 113, No. 2, 654-7 (Jan. 15, 1959).

The differential transition probability for the radiative decay of a polarized μ-meson with the most general choice of coupling constants, is calculated and integrated over electron energies. The extent to which this process may be useful for determining the coupling constants is discussed.

539.12

4925. CAPTURE AND DECAY OF μ^- MESONS IN Fe.

W.A.Barrett, F.E.Holmstrom and J.W.Keuffel.

Phys. Rev., Vol. 113, No. 2, 661-5 (Jan. 15, 1959).

The mean life of μ^- mesons in Fe was measured using an improved cosmic-ray apparatus. A positive identification of the stopped muon was made using Chevenkov velocity selectors in the incident telescope. The 2.2 μsec background from positive muons was reduced a factor of 3 with a 3-layer sandwich of Fe and thin plastic scintillators, so arranged that electrons emitted in the target were mostly detected as such by the scintillators. The mean life is 196 ± 8 mμsec. By comparing this result with the electron-counting results of Lederman and Weinrich, the ratio of the decay rate of μ^- bound in Fe to the free μ^+-decay rate is found to be 1.15 ± 0.06.

539.12

4926. LONGITUDINAL POLARIZATION OF THE FAST NEUTRONS FROM μ^- ABSORPTION BY NUCLEI.

M.Cini and R.Gatto.

Nuovo Cimento, Vol. 11, No. 2, 253-61 (Jan. 16, 1959).

The longitudinal polarization of the fast neutron emitted in the absorption of a negative muon by a nucleus is calculated for the $A \pm V$ interaction using a Fermi model for the nucleus. It is shown that, as long as this model can be applied to describe the process, the emitted neutron has an appreciable longitudinal polarization if the interaction is $A - V$. Rescattering corrections are estimated using an optical model and it is found that they do not alter this conclusion for the neutrons in the upper part of the spectrum.

539.12

4927. "ANOMALOUS" SCATTERING OF μ MESONS.

S.Fukui, T.Kitamura and Y.Watase.

Phys. Rev., Vol. 113, No. 1, 315-24 (Jan. 1, 1959).

A μ-meson scattering experiment is described in which the mesons are required to traverse a thick block of iron and stop and decay in a thin layer of carbon. Any uncertainty in the identity of the scattered particle has thus been eliminated, and further, the momentum of the particles is well defined. The observed angular distribution of the scattered μ mesons in the momentum range $(1_{-0.2}^{+0.15})$ BeV/c has been found to be in good agreement with the distribution predicted from the Coulomb scattering theory for extended nuclei obtained by Cooper and Rainwater. There is thus no indication from the present experiment for any anomalous scatterin of μ-mesons near 1 BeV/c momentum. The angular distribution of scattering of those particles which traversed the iron absorber but did not necessarily stop and decay in the carbon layer was not in good agreement with the Cooper and Rainwater theory, there being more than the expected number of particles scattered through large angles. It is shown, however, that the predicted scattering distribution, at large angles (assuming no anomalous contribution) arises almost entirely from the scattering of particles in 1-2 BeV/c regio and therefore is very sensitive to the assumed intensity in this region. It is concluded that the results from this part of the experiment cannot be accepted as evidence favouring the existence of anomalous scattering. The experimental results of other authors o the scattering of energetic μ mesons are summarized and discussed It is concluded that the evidence for anomalous interactions is not strong.

539.1

4928. IONIZATION LOSS BY COSMIC-RAY MU-MESONS IN ARGON.

G.Hall.

Canad. J. Phys., Vol. 37, No. 2, 189-202 (Feb., 1959).

The ionization of argon by cosmic-ray mu-mesons of minimum specific ionization was studied by means of a calibrated pressure-ionization chamber using electron collection. Corrections which ar shown to be necessary were applied to the experimental data. The shape of the experimental curve of statistical distribution of energy loss agrees with the theoretically predicted shape, for energy losse greater than the most probable loss (300 keV).

539.12

4929. CAPTURE OF NEGATIVE MUONS BY NUCLEI.

J.C.Sens.

Phys. Rev., Vol. 113, No. 2, 679-87 (Jan. 15, 1959).

An experiment conducted to obtain precise values for the rates at which negative muons are captured by nuclei is described. These capture rates were deduced from muon disappearance rates measured by determining the time distribution of electrons resulting from the decay of muons in their lowest atomic orbit. 30 elements were investigated, using scintillation counters as detectors. The data are compared with the general theory of Primakoff and the specific predictions of Tolhoek and Luyten for nuclei with $20 \leq Z \leq 28$ Primakoff's predictions for the effect of the Pauli principle are well borne out by this experiment, and the inferred capture rate of muons by protons is in good agreement with the hypothesis of a universal Fermi interaction. New values of effective nuclear charge densities (analogous to Wheeler's $Z_{eff}{}^4$) were computed for analysing the data, using a recent muon mass and up-to-date experimental information on charge distributions (from electron scattering and mesonic X-ray work). These new values are presented in tabular form.

539.12

4930. DEPOLARIZATION OF POSITIVE MUONS IN CONDENSED MATTER.

R.A Swanson.

Phys. Rev., Vol. 112, No. 2, 580-6 (Oct. 15, 1958).

The effects of parity nonconservation in the $\pi - \mu - e$ decay chain are used to measure the depolarization of positive muons in solids and liquids. Depolarization factors are given for some 30 materials, including commonly used experimental media. The asymmetry coefficient α for the angular distribution of positrons emitted by muons from positive pions at rest is found to be 0.303 ± 0.048.

539.12

4931. PHOTOPRODUCTION OF NEGATIVE π-MESONS ON DEUTERIUM NEAR THE THRESHOLD.

M.I.Adamovich, G.V.Kuz'micheva, V.G.Larionova and S.P.Kharlamov

Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 27-38 (1958). In Russian.

The investigation was performed with photographic emulsions containing D_2O. Detailed information on the reaction $\gamma + d \rightarrow p + p + \pi^-$ was obtained for photon energies up to 200 MeV. Various experimental characteristics of the reaction are compared with the predictions of the impulse approximation. The experimental results are consistent with the theory which takes into account interaction betwe nucleons in the final state. It is shown that the square of the matrix element for the photoproduction of π-mesons on neutrons near the meson threshold is a constant and equals $(0.785 \pm 0.072) \times 10^{-27}$ cm^2. This quantity corresponds to the ratio $\sigma^-/\sigma^+ = 1.34$.

539.12

4932. INVESTIGATION OF THE FINAL STATES INVOLVED IN THE PHOTOPRODUCTION OF NEGATIVE π-MESONS ON DEUTERIUM. M.I.Adamovich.

Zh. eksper. teor. Fiz., Vol. 35, No. 1(7), 39-44 (1958). In Russian.

The $\gamma + d \to p + p + \pi^-$ reaction was studied with the aid of photographic emulsions. The angular distributions and energy spectra of mesons and of the relative motion of two protons were obtained near the threshold of photoproduction of mesons. The analysis indicates the existence of an electric dipole transition which leads to a change of the spin of the nucleon system and to production of mesons in the S-state. The shape of the spectra and the energy dependence of the cross-section is explained, with interaction between nucleons in the final state.

539.12

4933. ENERGY DEPENDENCE OF THE ASYMMETRY PARAMETER OF π—μ—e DECAY IN NUCLEAR EMULSIONS.

C.Besson and V.Brisson-Fouché.

Nuovo Cimento, Vol. 10, No. 6, 1143-5 (Dec. 16, 1958).

The distribution, as a function of electron energy, in the asymmetry parameter "a" from 915 π—μ—e at rest is in good agreement with variations in "a" predicted by the two-component theory of the neutrino. The integrated value of a over the whole spectrum is 0.183 ± 0.058, corrected for selection bias. The Michel parameter is calculated ($\rho = 0.67 \pm 0.14$) and the possible sources of error in ρ discussed. S.J.St-Lorant

539.12

4934. DETERMINATION OF THE PION—NUCLEON COUPLING CONSTANT FROM PHOTOPRODUCTION ANGULAR DISTRIBUTION.

J.G.Taylor, M.J.Moravcsik and J.L.Uretsky.

Phys. Rev., Vol. 113, No. 2, 689-94 (Jan. 15, 1959).

The pion—nucleon coupling constant is determined from the pion photoproduction angular distribution. The method is based upon a certain conjecture concerning the analyticity of the photoproduction amplitude, and does not depend on the validity of any specific theory of photoproduction. It consists of an extrapolation of the angular distribution at any given fixed energy to $\cos\theta = V_\pi^{-1}$, where V_π is the pion velocity divided by the velocity of light. The amplitude at this nonphysical angle has a pole, and the pion—nucleon coupling constant is simple related to the residue of the amplitude. The quartic representation of photoproduction angular distributions is used as the functional form of the extrapolating curve. The most important feature of the new method is in the fact that it measures, at least in principle, the pion—nucleon coupling constant at any given fixed energy, while previous determinations in general measure the coupling constant in the low-energy limit, or require assumptions concerning the behaviour of the cross-section at all energies. In addition, the new method does not depend on the assumption of charge independence, and in fact measures explicitly the interaction of positive pions with nucleons. The scheme cannot be used for photoproduction of neutral pions. The method is applied to available data at 230, 260, 265, and 290 MeV photon energy in the laboratory system, and an over-all value of $f^2 = 0.064 \pm 0.041$ is obtained. In view of the large error, a detailed discussion is given of possible experiments which could give a more accurate value. Also discussed is the sensitivity of the value of the coupling constant to various features of the experiment, such as the energy of the photons, the relative importance of the relative and absolute normalizations, and the statistical errors on the individual pieces of data. Finally, numerical illustrations are given of the accuracy obtainable for certain given conditions on the factors listed above.

539.12

4935. DISPERSION RELATIONS FOR PION PRODUCTION IN A PION—NUCLEON COLLISION.

G.R.Screaton.

Nuovo Cimento, Vol. 11, No. 2, 229-52 (Jan. 16, 1959).

The dispersion relations for pion production are written down in terms of sixteen invariant functions and it is shown that the bound state terms can be evaluated from a knowledge of the dispersive part of pion—nucleon scattering.

539.12 : 530.145

4936. DISPERSION RELATIONS FOR THE $\pi + N \to \pi' + \pi'' + N'$ PROCESS IN THE FIXED-NUCLEON APPROXIMATION.

W.Zöllner, O.Chrustalow, W.Serebrjakow and A.Lesnow.

Z. Naturforsch., Vol. 13a, No. 7, 499-505 (July, 1958). In German.

It is shown that in the non-relativistic approximation a considerable region of the dispersion relation for the $\pi + N \to \pi' + \pi'' + N'$ process, developed with the aid of Bogoljubow's scheme, is covered by a continuous spectrum. Closer investigation of the spectrum leads to complicated integral equations connecting the hermitian and anti-hermitian parts of the amplitudes. The dispersion relations are used to set up an equation satisfying all the symmetry requirements of Chew—Low type of equations. S.J.St-Lorant

539.12

4937. π^+—p INTERACTIONS IN THE ENERGY RANGE AROUND 500 MeV.

M.E.Blevins, M.M.Block and J.Leitner.

Phys. Rev., Vol. 112, No. 4, 1287-94 (Nov. 15, 1958).

A hydrogen-filled diffusion cloud chamber investigation of π^+—p interactions in the energy range around 500 MeV is reported. The elastic scattering angular distribution, based on a total of 180 events, is analysed using only s and p waves, and also using s and p waves with a d-wave interference term. Phase shifts are presented and ambiguities are discussed. The d-wave contribution is small. The elastic cross-section is used to compute the real part of the forward coherent scattering amplitude. The latter is in good agreement with that predicted by the dispersion relations. Inelastic production sets in at about 300 MeV. Eighteen inelastic events were found; 7 were p + 0, 7 were n^{++}, and 4 were unidentifiable. Inelastic processes are discussed in terms of various models.

539.12

4938. PION—NUCLEON PHASE SHIFTS FOR INTERMEDIATE ENERGIES.

H.Y.Chiu and E.L.Lomon.

Ann. Phys. (New York), Vol. 6, No. 1, 50-69 (Jan., 1959).

The pion—nucleon scattering at 150, 170, 220 and 307 MeV is analysed into S and P state phase shifts. The best Fermi-type solutions are found, and the statistically plausible ranges of the phase shifts are obtained. At 150 and 170 MeV it is found that $(\delta_{13} - \delta_{31}) > 3^\circ$. At 220 and 307 MeV, three optimal Fermi-type solutions are found, one corresponding to a continuation of the lower energy solutions. The other two solutions are not both continuous with those below resonance nor do they satisfy both the available recoil proton polarization data and the dispersion relations. Data at other energies are consistent with the interpolated or extrapolated phase shifts. The continuous set of phase shifts is consistent with a k^3 variation of the small p-wave phase shifts. δ_1 shows a tendency to increase less than linearly by 220 MeV. A Chew—Low plot of δ_{33} fits a straight line up to 220 MeV, with $f^2 = 0.08$ and the resonance at 195 ± 4 MeV.

539.12

4939. MEASUREMENT OF THE MULTIPLE SCATTERING OF π-MESONS STOPPING IN NUCLEAR EMULSION USING THE TANGENT METHOD.

B.Dépaux.

J. Phys. Radium, Vol. 20, No. 1, 16-19 (Jan., 1959). In French.

The multiple scattering of 40 π-mesons was measured. The direction of a double cell can be determined from the mean direction of two consecutive single cells forming the double cell. The "noise" between double and single cells can thus be eliminated. Formulae proposed for the elimination are verified by this study. The multiple scattering constant deduced from the study of π-mesons of energy 6 to 12 MeV is, within experimental error, in good agreement with the theoretical value. The distribution of scattering angles is Gaussian for angles 4 times smaller than the mean angle, but for greater angles, there is a significant excess. The ratio between the second difference and the angle of multiple scattering is of the same order as that found by the sagitta method.

539.12

4940. QUASI-ELASTIC SCATTERING OF PIONS BY NUCLEI.

T.K.Fowler.

Phys. Rev., Vol. 112, No. 4, 1325-35 (Nov. 15, 1958).

Discusses a prescription, based upon the impulse approximation, for estimating the inelastic contamination generally present in attempted measurements of elastic pion—nucleus differential scattering cross-sections because of the finite energy resolution of detectors. It is also pointed out that in such quasi-elastic measurements the interference portion of the inelastic scattering, for which the form factor is the Fourier transform of the important and unknown nucleon pair correlation density, is experimentally separated from the direct inelastic scattering over a large range of scattering angles.

539.12

4941. DETERMINATION OF THE PION—NUCLEON SCATTERING AMPLITUDE FROM DISPERSION RELATIONS AND UNITARITY. GENERAL THEORY.

S.Mandelstam.

Phys. Rev., Vol. 112, No. 4, 1344-60 (Nov. 15, 1958).

A method is proposed for using relativistic dispersion relations, together with unitarity, to determine the pion—nucleon scattering amplitude. The usual dispersion relations by themselves are not sufficient, and we have to assume a representation which exhibits the analytic properties of the scattering amplitude as a function of the energy and the momentum transfer. Unitarity conditions for the two reactions $\pi + N \rightarrow \pi + N$ and $N + \bar{N} \rightarrow 2\pi$ will be required, and they will be approximated by neglected states with more than two particles. The method makes use of an iteration procedure analogous to that used by Chew and Low for the corresponding problem in the static theory. One has to introduce two coupling constants; the pion—pion coupling constant can be found by fitting the sum of the threshold scattering lengths with experiment. It is hoped that this method avoids some of the formal difficulties of the Tamm—Dancoff and Bethe—Salpeter methods and, in particular, the existence of ghost states. The assumptions introduced are justified in perturbation theory. As an incidental result, one finds the precise limits of the region for which the absorptive part of the scattering amplitude is an analytic function of the momentum transfer, and hence the boundaries of the region in which the partial-wave expansion is valid.

539.12

4942. HIGH-ENERGY MAXIMA IN THE π–p CROSS SECTIONS.
R.K.Adair.

Phys. Rev., Vol. 113, No. 1, 338-41 (Jan. 1, 1959).

Consideration of causality requires that any description of the maximum in the π^-–p total cross-section at 800 MeV π^--energy, and the maximum in the π^+–p cross-section at 1200 MeV, is necessarily equivalent to a description in terms of resonances and hence in terms of nucleon isobars.

539.12

4943. π^-–p SCATTERING BELOW 1 BeV.
R.R.Crittenden, J.H.Scandrett, W.D.Shephard, W.D.Walker and J.Ballam.

Phys. Rev. Letters, Vol. 2, No. 3, 121-4 (Feb. 1, 1959).

Measurement of the total and differential cross-sections for pion momenta 590, 750 and 890 MeV/c using a propane bubble chamber. The results are consistent with a resonance in π^-–p scattering at 600 MeV. C.J.Batty

539.12

4944. PHOTOPRODUCTION OF PION PAIRS IN HYDROGEN.
M.Bloch and M.Sands.

Phys. Rev., Vol. 113, No. 1, 305-15 (Jan. 1, 1959).

This was observed by detecting, in a magnetic spectrometer, the negative pions which emerged at 60° and at 120° from a hydrogen target in the bremsstrahlung beam of an electron synchrotron. The yields of negative pions "per equivalent quantum" were measured for several values of the pion energy and the bremsstrahlung cutoff energy. From the variations of the yields with bremsstrahlung cutoff energy, the cross-section for the emission of negative pions was obtained. The cross-section shows no large dependence on the pion angle from 90° to 150° in the c.m. system. The integral of the cross-section over the negative pion energy is consistent with a constant value of about 4×10^{-30} cm²/sterad for photon energies between 600 and 1100 MeV. The observed dependence of the cross-section on pion energy has been compared to some phenomenological models.

539.12

4945. PROOF OF DISPERSION RELATIONS FOR THE PRODUCTION OF PIONS BY REAL AND VIRTUAL PHOTONS AND FOR RELATED PROCESSES.
R.Oehme and J.G.Taylor.

Phys. Rev., Vol. 113, No. 1, 371-80 (Jan. 1, 1959).

It is shown that the amplitudes for the production of pions by photons and electrons (virtual photons), as well as for elastic photon—proton scattering, have certain analytic properties as functions of energy and momentum transfer. These properties are proven on the basis of the axioms of field theory, especially local commutativity and the spectral conditions. They guarantee the validity of the usual dispersion relations for restricted values of the invariant momentum transfer. In the construction of these dispersion formulae the electromagnetic interaction is treated in lowest order. The residua of the poles arising from the single-particle intermediate states are related to the corresponding vertex functions. For fixed values of the total energy the absorptive parts of the amplitudes are analytic functions of momentum transfer; they are regular inside certain ellipses. These properties make it possible to continue the absorptive parts into the "unphysical region" appearing in the nonforward dispersion relations by means of partial-wave expansions. In an appendix a brief survey is given of the limitations in momentum transfer or the unphysical mass restrictions, which one encounters in the proof of dispersion relations for some elastic scattering processes.

539.1

4946. INTERACTION CURRENT IN STRANGENESS-VIOLATING DECAYS.
S.Okubo, R.E.Marshak, E.C.G.Sudarshan, W.B.Teutsch and S.Weinberg.

Phys. Rev., Vol. 112, No. 2, 665-8 (Oct. 15, 1958).

The consequences of the hypothesis that the current of strongl interacting particles contributing to strangeness-violating decays has the transformation properties of an isospinor are investigated. The six processes $K^+ \rightarrow \pi^0 + \mu^+ + \nu$, $K^- \rightarrow \pi^0 + \mu^- + \bar{\nu}$, $K_1{}^0 \rightarrow \pi^+ + \mu^- +$ $K_1{}^0 \rightarrow \pi^- + \mu^+ + \nu$, $K_2{}^0 \rightarrow \pi^+ + \mu^- + \bar{\nu}$, $K_2{}^0 \rightarrow \pi^- + \mu^+ + \nu$ would then have the same rates, angular correlations, spectra, etc., and likewise for electron modes. This prediction is compared with availab experimental data. The evidence from the non-lepton decays is briefly examined.

539.1

4947. PION SPECTRUM IN RADIATIVE K_π^+ DECAY.
J.D.Good.

Phys. Rev., Vol. 113, No. 1, 352-5 (Jan. 1, 1959).

The π^+ energy spectrum is calculated for the process $K^+ \rightarrow \pi^+ + \pi^0 + \gamma$, taking into account the processes of internal brem strahlung and of direct dipole emission, both E1 and M1 transitions being permitted with parity nonconservation for weak decays. For the π^+ energy range 55-75 MeV, which was examined in some recen investigations, the internal bremsstrahlung process alone leads to an expectation of 1.0 anomalous K_π^+ decay in the 8653 K^+ decays examined, quite compatible with the observation of two anomalous K_π^+ decays in these data. For reasonable values of the dimensionles parameters $A(\mu/M)^4$ and $B(\mu/M)^4$ which specify the dipole transition strengths, (that is, with $A = B = 1$ and M equal to the K-particle mass), it appears that their main contribution will arise from the interference of the E1 direct transition with the internal bremsstrahlung term, increasing or decreasing the above estimate by about 20%.

539.12

4948. ISOTOPIC SPIN SELECTION RULES AND K_2^0 DECAY.
S.Okubo, R.E.Marshak and E.C.G.Sudarshan.

Phys. Rev. Letters, Vol. 2, No. 1, 12-14 (Jan. 1, 1959).

The consequences of the the "$\Delta I = \frac{1}{2}$" and of the "$I = \frac{1}{2}$ current" rules for the weak interactions of strange particles are considered. The former rule appears to lead to a value for the transition rate of $K_2^0 \rightarrow \pi^+ + \pi^- + \pi^0$ which is at variance with the observed value. The observed value, however, depends on the observed K_2^0 lifetime which has large errors. It is also noted that for any rule $K_2^0 \rightarrow 3\pi^0$ is forbidden if CP invariance holds. This will also apply to $K_2^0 \rightarrow \pi^+ + \pi^- + \pi^0$ if the 3 pion space wave-function is completely symmetric. A.Ashmore

539.12

4949. THE BRANCHING RATIO OF THE DECAY OF THE K^+-MESON.
W.T.Lee, D.C.Sen, T.H.Ho and H.Y.Tzu.

Scientia Sinica, Vol. 8, No. 1, 48-60 (Jan., 1959).

The branching ratio of the following three modes of K^+-meson decay

$$K^+ \rightarrow \mu^+ + \pi^0 + \nu$$
$$K^+ \rightarrow e^+ + \pi^0 + \nu$$
$$K^+ \rightarrow \mu^+ + \nu$$

was calculated by using the theory of the universal Fermi weak interaction proposed by Feynman and others. The perturbation method with cut-off is used. The ratio obtained is 1:1.5:12, which is in fair agreement with the experimental value 1:1:15. It is shown that other combinations of the Fermi interactions cannot give result in agreement with experiment.

539.12

4950. NEGATIVE K-MESON REACTIONS WITH PROTONS: MASSES OF CHARGED Σ HYPERONS AND THE NEGATIVE K MESON.
W.H.Barkas, J.N.Dyer, P.C.Giles, H.H.Heckman, C.J.Mason, N.A.Nickols and F.M.Smith.

Phys. Rev., Vol. 112, No. 2, 622-3 (Oct. 15, 1958).

New measurements of the masses of the charged Σ hyperons and the negative K-meson are reported. The results obtained are $M_{\Sigma^+} = 1189.3 \pm 0.3$ MeV, $M_{\Sigma^-} = 1195.8 \pm 0.5$ MeV, and $M_{K^-} = 493.87 \pm 0.46$ MeV. No evidence for more than one K^--mesons mass was found. The terminal behaviour of the Σ^- hyperons was also studied.

539.12

4951. RADIATIVE CAPTURE OF K^- MESONS FROM ORBITAL P STATES OF K-MESONIC ATOMS.
G.Frye.

Phys. Rev., Vol. 113, No. 2, 688-9 (Jan. 15, 1959).

The photon spectrum accompanying the radiative capture of

K^- mesons from orbital P states of K-mesonic hydrogen atoms is discussed.

539.12

4952. COMPOUND MODEL AND THE RELATIVE PARITY OF BARYONS. Y.Oishi.
Nuovo Cimento, Vol. 11, No. 1, 124-5 (Jan. 1, 1959).

If all strongly interacting particles are compounds of nucleons and Λ-particles bound in s-states their parities are determined and seem not to conflict with experiment. J.C.Taylor

539.12

4953. EXPERIMENTAL DETERMINATION OF THE Λ SPIN. F.S.Crawford, Jr, M.Cresti, M.L.Good, M.L.Stevenson and H.K.Ticho.
Phys. Rev. Letters, Vol. 2, No. 3, 114-16 (Feb. 1, 1959).

The spin is found to be $\frac{1}{2}$, using the method suggested by Lee and Yang (Abstr. 554/1959). The Λ's were produced in a 10 in. liquid hydrogen bubble chamber by the reaction $\pi^- + p \rightarrow k^0 + \Lambda$ using pions of momenta between 0.95 and 1.23 BeV/c.

C.J.Batty

539.12

4954. Ξ^- CAPTURE REACTIONS IN HYDROGEN. S.B.Treiman.
Phys. Rev., Vol. 113, No. 1, 355-7 (Jan. 1, 1959).

In the capture reaction $\Xi^- + p \rightarrow \Lambda + \Lambda$, the asymmetries in the Λ decays constitute an excellent analyser for determining the polarization pattern of the Λ's and hence the nature of the final orbital states involved. Such information, together with evidence concerning alternate capture channels $\Xi^- + p \rightarrow \Xi^0 + n$, $\Xi^- + p \rightarrow \Lambda + \Lambda + \gamma$, may permit a determination of the parity of Ξ relative to that of the nucleon.

539.12

4955. HYPERON—ANTIHYPERON PRODUCTION IN NUCLEON—ANTINUCLEON COLLISIONS AND THE RELATIVE Σ—Λ PARITY. S.Barshay.
Phys. Rev., Vol. 113, No. 1, 349-51 (Jan. 1, 1959).

Collisions near threshold are discussed. The rate for the reaction and the polarization of the outgoing baryons are calculated in terms of three amplitudes characterizing the transition operators in the two cases of even and odd relative Σ—Λ parity. In terms of these amplitudes, a correlation function which gives the angular correlations between the pion momenta from the subsequent decay of the hyperon and antihyperon, and the vectors involved in the production process, is given for each relative parity. The possibility of this class of experiments being useful in determining the relative Σ^0—Λ parity, as well as the relative charged Σ—Λ parity, is discussed.

539.12

4956. FURTHER SEARCH FOR PARITY NONCONSERVATION IN ASSOCIATED PRODUCTION. F.S.Crawford Jr, M.Cresti, M.L.Good, F.T.Solmitz and M.L.Stevenson.
Phys. Rev. Letters, Vol. 2, No. 1, 11-12 (Jan. 1, 1959).

The decay asymetry in the production of Λ particles produced in the reaction $\pi^- + p \rightarrow \Lambda + K^0$ was measured using 1.23 BeV/c pions and found to be consistent with zero, indicating that parity is largely conserved in associated production. C.J.Batty

539.12

4957. PRODUCTION OF STRANGE PARTICLES AND ANTI-PARTICLES IN NUCLEAR INTERACTIONS OF VERY HIGH ENERGY ($E \sim 10^{13}$ eV). E.Lohrmann and M.W.Teucher.
Phys. Rev., Vol. 112, No. 2, 587-9 (Oct. 15, 1958).

The production of strange particles, nucleons and antibaryons (antinucleons and antihyperons) in nuclear collisions of an energy between 10^{12} and 10^{14} eV was studied by looking for high-energy interactions produced by the secondary particles. The ratio of secondary interactions initiated by neutral particles to those initiated by charged particles was found to be $Q = 0.16 \pm 0.06$. Under reasonable assumptions, these data indicate that $9_{-6}^{+8}\%$ of the high-energy charged secondary particles are charged K-mesons or baryons and antibaryons. The average energy of the primary collisions used in our analysis is estimated to be of the order of 10^{13} eV.

539.12 : 535.376

THE LUMINESCENCE EXCITATION EFFECT OF α-PARTICLES OF DIFFERENT ENERGIES ON ACTIVATED ZINC SULPHIDE. See Abstr. 4470

NUCLEUS

539.14

4958. SHAPE OF THE NUCLEUS. L.Wilets.
Science, Vol. 129, 361-7 (Feb. 13, 1959).

Review article for non-specialists.

539.14

4959. RESEARCHES ON THE PROBABLE NATURE OF CERTAIN ATOMIC AND NUCLEAR FORCES. T.T.Vescan.
Rev. de Physique (Bucarest), Vol. 2, No. 2, 165-73 (1957). In French.

A summary of some attempts to understand nuclear forces in terms of the classical interaction of electric charges.

R.J.N.Phillips

539.14

4960. THE THREE- AND FOUR-BODY PROBLEM IN NUCLEAR PHYSICS. H.J.Mang and W.Wild.
Z. Phys., Vol. 154, No. 2, 182-217 (1959). In German.

The equations of the independent-pair model applied to three- and four-body interactions are solved by perturbation methods for the case of charge and spin independent central two-body forces with a hard core. The average nuclear potential is approximated, in the lowest order, by an oscillator potential including an effective mass, with the parameters chosen to give maximum self-consistency for the potential. For a square-well two-body force the equations are solved exactly, the corrections appear small. Tests for internal consistency of the method are made, and following Lipkin the energy of the centre-of-mass motion separated. The binding energies of He^4 and H^3, the energy difference between H^3 and He^3 and the r.m.s. radius of He^4 are deduced and shown to be in reasonable agreement with experiment. S.J.St-Lorant

539.14

4961. EFFECT OF PAIRING CORRELATIONS ON NUCLEAR PROPERTIES. S.T.Belyaev.
K. Danske Vidensk. Selsk. mat.-fys. Medd., Vol. 31, Paper 11, 54 pp. (1959).

A method analogous to that developed in the new theory of superconductivity is applied to nuclei in order to investigate the influence of the coherent pairing interaction on various nuclear properties, especially on collective motion. The finite size effects, in particular the shell structure of the single-particle levels, are considered. The pairing correlation between two nucleons in states of opposite angular momentum projections is taken into account by means of a canonical transformation from the original interacting nucleons to new independent quasi-particles. For strongly deformed nuclei, the moment of inertia is rather sensitive to the effect of pairing correlations and is found to be reduced from the value for rigid rotation by a factor of the order of that observed. For nuclei in regions near closed shells, the pairing correlations give rise to a spherical equilibrium shape and low energy vibrational modes of excitations. The vibrational frequencies and inertial parameters obtained from the present model are in qualitative agreement with experimental data and fit the observed trends.

539.14

4962. STRUCTURE OF THE NUCLEAR MASS SURFACE. G.A.Baker, Jr.
Phys. Rev., Vol. 112, No. 3, 954-59 (Nov. 1, 1958).

The nuclear mass surface is analysed in terms of its observed structural properties, and a formula is developed for the binding energy, which is easy to use and is accurate, over all, to ±0.54 MeV, and, for $A > 214$, to ±0.27 MeV.

539.14

4963. EFFECTIVE CHARGE OF NEUTRONS IN NUCLEI. A.de-Shalit.
Phys. Rev., Vol. 113, No. 2, 547-51 (Jan. 15, 1959).

The polarization of closed proton shells by neutrons can be considered as inducing an effective charge on the neutron for some multipoles but not for others. The rough constancy of the effective neutron charge as observed in E2 transitions and quadrupole moments in nondeformed odd N-even Z nuclei is discussed, and arguments are presented to explain this phenomenon along the lines of the shell model.

539.14 : 530.145

APPLICATION OF PERTURBATION METHODS TO THE THEORY OF NUCLEAR MATTER. See Abstr. 4284

539.14

4964. REVISED WEIZSÄCKER SEMIEMPIRICAL FORMULA FOR DIFFUSE NUCLEAR SURFACES. W.D.Gunter,Jr and R.A.Hubbs.
Phys. Rev., Vol. 113, No. 1, 252-5 (Jan. 1, 1959).

An attempt is made to modify the Weizsäcker semiempirical mass formula to include effects of the diffuse nuclear surface indicated by recent electron scattering experiments. Volume and surface effects are combined by integrating over an assumed trapezoidal density function similar to that found experimentally. Good fits to the experimental nuclear masses are achieved with r_0 (a radius parameter) and ϵ (half the surface depth) equal to 1.081×10^{-13} cm and 1.202×10^{-13} cm, respectively. These are in reasonably good agreement with the experimental values $(1.07 \times 0.02) \times 10^{-13}$ cm and $(1.50 \pm 0.20) \times 10^{-13}$ cm found by Hahn, Ravenhall, and Hofstadter.

539.14

4965. NUCLEAR SPIN OF 12.6 HOUR IODINE-130.
H.L.Garvin, T.M.Green and E.Lipworth.
Phys. Rev. Letters, Vol. 1, No. 8, 292-3 (Oct. 15, 1958).

The nuclear spin was measured by means of an atomic beam magnetic resonance experiment (Abstr. 569/1959) and found to be 5. I^{130} was produced by bombarding powdered tellurium with 12 MeV protons. Iodine was evaporated off the target on to platinum and separated chemically. Both resonances possible with a $^2P_{3/2}$ electronic ground state were observed. The isotope was identified by its half-life and by its gamma-ray spectrum. The value 5 for the nuclear spin of I^{130} is consistent with the single-particle shell model. It is likely that the odd neutron occupies the $2d_{3/2}$ level.

P.G.Murphy

539.14

4966. HYPERFINE-STRUCTURE SEPARATIONS AND MAGNETIC MOMENTS OF Cs^{127}, Cs^{129}, Cs^{130}, AND Cs^{132}.
W.A.Nierenberg, H.A.Shugart, H.B.Silsbee and R.J.Sunderland.
Phys. Rev., Vol. 112, No. 1, 186-90 (Oct. 1, 1958).

The atomic hyperfine-structure separations and magnetic moments of four neutron-deficient caesium isotopes were measured by an atomic-beam magnetic-resonance method as

Isotope	h.f.s., $\Delta\nu$ (Mc/s)	Magnetic moment, μ (nm)
Cs^{127}(6.2 hr, $I = \frac{1}{2}$)	8950 ± 200	+1.43 ± 0.04
Cs^{129}(31 hr, $I = \frac{1}{2}$)	9200 ± 200	+1.47 ± 0.04
Cs^{130}(30 min, $I = 1$)	6400 ± 350 for	+1.37 ± 0.08
	6800 ± 350 for	−1.45 ± 0.08
Cs^{132}(6.2 days, $I = 2$)	8648 ± 35	+2.22 ± 0.02

The spin measurement of Cs^{132} is discussed.

539.14

4967. EVALUATION OF NUCLEAR QUADRUPOLE MOMENTS IN NILSSON'S SCHEMA. D.Bogdan.
Nuovo Cimento, Vol. 10, No. 6, 985-93 (Dec. 16, 1958). In French.

The expectation value of the ordinary quadrupole operator [i.e., without contribution from the core] is evaluated with Nilsson's wave-functions (Abstr. 3526/1957). The approximation is made, that the motion of the deformed nuclear field does not disturb the individual particle motions. It is found, that in the region $150 < A < 188$, it is necessary to take into account the coupling between states with different N.

J.Lascoux

539.14

4968. NUCLEAR RADII FROM ALPHA-PARTICLE SCATTERING AND ALPHA-RADIOACTIVITY. J.O.Rasmussen.
Rev. mod. Phys., Vol. 30, No. 2(I), 424-9 (April, 1958).

"Nuclear sizes and density distributions" paper, see Abstr. 6217 (1958). The radius determinations with sharp cutoff models are compared with the interpretations in terms of diffuse potentials. Although the optical model does not produce a unique fit, there seems to be some evidence that the real attractive potential becomes more attractive with increasing alpha energy, the reverse of the trend for protons or neutrons.

J.Lascoux

539.14

4969. POLARIZATION OF THE NUCLEUS AND THE TIDAL EFFECT IN μ-MESIC ATOMS. E.Nuding.
Z. Naturforsch., Vol. 12a, No. 3, 187-94 (1957). In German.

The influence of polarization of the atomic nucleus on the 1s, 2p and 3d levels of μ-mesic atoms is calculated for Sb, W, Pb and U, using a second-order perturbation method and assuming a Steinwedel—Jensen nuclear model. The results are in agreement with the nuclear model within 5%. The correction for the differences in the 2p—1s terms appears to be almost independent of Z and is of the order of 5 keV. The tidal effect gives a contribution for the 1s state which i surprisingly high (~ 10 keV) when compared with that arising from polarization.

G.Martell

539.1

4970. COLLECTIVE EXCITATIONS OF NUCLEAR MATTER.
A.E.Glassgold, W.Heckrotte and K.M.Watson.
Ann. Phys. (New York), Vol. 6, No. 1, 1-36 (Jan., 1959).

A study of the collective motions of nuclear matter is made. A purely classical macroscopic description is given of hydrodynamic waves in nuclear matter, together with some experimental consequences of their excitation. A quantum mechanical study is made of the collective eigenstates of nuclear matter, the starting point being the theory of the nuclear ground state as given by Brueckner and collaborators. The excited states are described by means of the method developed by Sawada to apply to an electron gas. This method is generalized so as to include the internal degrees of freedom associated with spin and i-spin and to handle the momentum dependence of the level-shift operator K used by Brueckner. The connection between the quantum-mechanical eigenstates and the classical hydrodynamic motion is established. As a consequence of the internal degrees of freedom, there exist not only the usual compressive waves, but spin, i-spin, and coupled spin-i-spin waves. The i-spin waves can be associated with the Goldhaber—Teller oscillations. The corrections to the Sawada theory are investigated. This gives rise to the damping of the stable Sawada collective eigenmodes, analogous to the viscous damping of a plasma oscillation. The spin and i-spin waves are only slightly damped, whereas the compressional mode is unstable in an exponentially growing sense.

539.14

4971. SPACINGS OF NUCLEAR ENERGY LEVELS. L.Dresner.
Phys. Rev., Vol. 113, No. 2, 633-5 (Jan. 15, 1959).

A simple statistical model is suggested in terms of which the general features of the level spacing distribution can be understood, and which involves no special assumptions, other than that of Porter and Thomas.

539.14

4972. CLASSIFICATION OF THE ENERGY LEVELS OF ODD-MASS NUCLEI IN THE HEAVY-ELEMENT REGION.
F.S.Stephens, F.Asaro and I.Perlman.
Phys. Rev., Vol. 113, No. 1, 212-24 (Jan. 1, 1959).

Most of the data available on energy levels in odd-mass nuclei of the heaviest elements have been summarized and evaluated. The observed levels have been classified according to the level diagrams calculated by Nilsson (see Abstr. 3526/1957) for nuclei with prolate spheroidal deformations. Qualitatively, the agreement between the data and the Nilsson diagrams is very good.

539.14

4973. SEARCH FOR ELECTRIC MONOPOLE PAIRS FROM THE 3.82 MeV STATE OF Ca^{48}. K.E.Eklund and R.D.Bent.
Phys. Rev., Vol. 112, No. 3, 966-7 (Nov. 1, 1958).

A search was made for 3.82 MeV electric monopole pairs from the reaction $Ca^{48}(p,p')Ca^{48*}$ using a $CaCO_3$ (35% Ca^{40}, 62% Ca^{48}) target, 6.0 MeV protons, and an intermediate-image spectrometer. No 3.82 MeV pairs from Ca^{48} were observed with an intensity as great as 0.3% that of the 3.35 MeV electric monopole pairs from Ca^{40}. This result suggests that the 3.82 MeV state of Ca^{48} decays predominantly by gamma emission. This could occur if the 3.82 MeV state has spin > 0, or if there are lower excited states in Ca^{48}.

539.14

4974. SEARCH FOR ELECTRIC MONOPOLE PAIRS FROM THE 7.6 MeV STATE OF C^{12}. T.H.Kruse and R.D.Bent.
Phys. Rev., Vol. 112, No. 3, 931-2 (Nov. 1, 1958).

A search was made for weak 7.6 MeV electron monopole pairs from the reaction $Be^9(\alpha,n)C^{12*}$ using a thin target, 5.7 MeV alpha particles, and a scintillation pair spectrometer. No 7.6 MeV pairs were seen with an intensity as great as 1.6×10^{-5} that of 4.43 MeV gamma rays. This result gives a limit of $\Gamma_{\pm e}/\Gamma_{total} < 1.3 \times 10^{-4}$ for the ratio of the partial width for pair emission to the total width of the 7.6 MeV state. If an estimated alpha-particle width of 0.5 eV is taken for the total width of the 7.6 MeV state, then an upper limit of $\Gamma_{\pm e} < 7 \times 10^{-5}$ eV is obtained for the partial width for pair emission of the 7.6 MeV state.

539.14

4975. INHIBITION OF MAGNETIC DIPOLE RADIATION AND THE IDENTIFICATION OF T = 1 STATES IN LIGHT, SELF-CONJUGATE NUCLEI. E.K.Warburton.
Phys. Rev., Vol. 113, No. 2, 595-601 (Jan. 15, 1959).

The effects of Coulomb impurities on the inhibition rule of

Morpurgo for $\Delta T = 0$, M1 transitions in light ($A \leq 20$), self-conjugate nuclei are discussed and a comparison is made between Morpurgo's rule and the experimentally known M1 transition strengths. An upper limit to the average inhibition of ~ 10 is indicated by the experimental evidence. There are no known $\Delta T = 0$, M1 transitions in light, self-conjugate nuclei with strengths greater than 0.1 Weisskopf unit. The work of Morpurgo is shown to lead to J-dependent lower limits of the order of $0.5 \times 10^{-2} A(A+2)$ Weisskopf units for the matrix elements of $\Delta T = 0$, M1 transitions in self-conjugate nuclei. These limits are invoked to assign isotopic spin to several levels in B^{10}, N^{14}, and F^{18}.

539.14

4976. 7.65 MeV STATE OF C^{12}. S.F.Eccles and D.Bodansky.
Phys. Rev., Vol. 113, No. 2, 608-13 (Jan. 15, 1959).

The angular distribution for the inelastic scattering of 42 MeV alpha-particles by C^{12}, with excitation of the 7.65 MeV state, was measured. The experimental distribution shows maxima and minima consistent with 0^+ or 2^+ spin-parity assignment for the 7.65 MeV state, on an Austern, Butler, McManus type of direct interaction theory. A search was made for coincidences between the inelastically scattered alpha-particles and recoil carbon nuclei in an attempt to determine the probability that the 7.65 MeV state decays by transitions to the ground state of C^{12}. It was found that there is less than one chance in ten that this probability exceeds 0.1%. This low probability is not inconsistent with current theories of helium burning in stars and provides additional support for the usual 0^+ assignment for the 7.65 MeV state.

539.14 : 539.17

4977. EXCITED STATES OF Cu^{64} AND Cu^{66}.
R.P.de Figueiredo, M.Mazari and W.W.Buechner.
Phys. Rev., Vol. 112, No. 3, 873-6 (Nov. 1, 1958).

The $Cu^{63}(d,p)Cu^{64}$ and $Cu^{65}(d,p)Cu^{66}$ reactions were investigated through studies of the proton groups arising from the deuteron bombardment of thin targets of isotopically enriched copper. The incident deuteron beam, with energies ranging from 6.00 to 6.55 MeV, was obtained from an electrostatic accelerator, and the protons were analysed with a high-resolution magnetic spectrograph. In the region of excitation up to 3.80 MeV, sixty-five excited states in Cu^{64} and fifty-five in Cu^{66} were measured. The Q values for the transitions to the ground states of Cu^{64} and Cu^{66} are 5.691 ± 0.008 MeV and 4.832 ± 0.008 MeV, respectively.

539.14

4978. LIFETIMES OF THE FIRST EXCITED STATES OF F^{17} AND B^{10}. R.E.Holland, F.J.Lynch and S.S.Hanna.
Phys. Rev., Vol. 112, No. 3, 903-5 (Nov. 1, 1958).

The mean life of the first excited state of F^{17} was measured using a pulsed-beam technique. The mean life is definitely < 0.5 mμsec. The result obtained is (0.35 ± 0.15) mμsec with the upper limit more firmly established than the lower. A value of 495 ± 15 keV was obtained for the excitation energy in F^{17}. A measurement of the mean life of the first excited state of B^{10} gave a value of (0.90 ± 0.1) mμsec.

539.14

4979. ENERGY LEVELS IN F^{19} FROM THE $O^{18}(d,n\gamma)F^{19}$ REACTION. J.W.Butler, L.W.Fagg and H.D.Holmgren.
Phys. Rev., Vol. 113, No. 1, 268-72 (Jan. 1, 1959).

The gamma-ray threshold technique was applied to the $O^{18}(d,n\gamma)F^{19}$ reaction in the range of deuteron bombarding energies from 1.55 to 3.36 MeV. Four gamma-ray thresholds have been observed: 1.85 ± 0.05, 2.15 ± 0.05, 2.64 ± 0.03, and 3.16 ± 0.03 MeV, corresponding to excited states in F^{19} at 7.40 ± 0.05, 7.67 ± 0.05, 8.11 ± 0.03, and 8.58 ± 0.03 MeV, respectively.

539.14 : 539.17

4980. FIRST EXCITED STATE OF B^{11} AND SPIN–FLIP STRIPPING. J.E.Bowcock.
Phys. Rev., Vol. 112, No. 3, 923-6 (Nov. 1, 1958).

A theoretical treatment is presented of the anomalous angular distribution in the $B^{10}(d,p)B^{11}$ reaction to the first excited state of the final nucleus. The experimental distribution is characteristic of the orbital angular momentum of the captured neutron being 1. However, the known spins and parities of the target and final state nuclei do not admit this value. By coupling the spin of the stripped proton to the spin of the target nucleus plus neutron, an extra unit of angular momentum may be imparted to this system allowing the final state to be reached. The angular distribution from such a mechanism is calculated and fits rather well the experimental curves.

539.14 : 539.17

4981. NEUTRON THRESHOLDS IN THE $V^{51}(p,n)Cr^{51}$, $Mn^{55}(p,n)Fe^{55}$, $Zn^{70}(p,n)Ga^{70}$, AND $As^{75}(p,n)Se^{75}$ REACTIONS.
C.R.Gossett and J.W.Butler.
Phys. Rev., Vol. 113, No. 1, 246-51 (Jan. 1, 1959).

The two-counter slow-to-fast ratio technique was used with proton energies up to about 2 MeV in a study of neutron thresholds from these four reactions. In the $V^{51}(p,n)Cr^{51}$ reaction, the ground-state threshold was measured to be 1.564 ± 0.002 MeV. No excited states were observed in the region of excitation from zero to 0.41 MeV. In the $Mn^{55}(p,n)Fe^{55}$ reaction, the ground-state threshold was measured to be 1.034 ± 0.002 MeV. Excited-state thresholds were found at 1.455 ± 0.003 and 1.982 ± 0.002 MeV, corresponding to energy levels in Fe^{55} at 0.414 ± 0.003 and 0.931 ± 0.002 MeV, respectively. In the $Zn^{70}(p,n)Ga^{70}$ reaction, the ground-state threshold was measured to be 1.457 ± 0.002 MeV. No excited states were observed in the region of excitation from zero to 0.53 MeV. In the $As^{75}(p,n)Se^{75}$ reaction, the ground-state threshold was measured to be 1.669 ± 0.002 MeV. An excited state threshold was found at 1.960 ± 0.002 MeV, corresponding to an energy level in Se^{75} at 0.287 ± 0.002 MeV. A two-counter detector of high sensitivity and a low-background experimental arrangement are described.

539.14 : 539.17

O^{16} EXCITED STATES. See Abstr. 3889

539.14 : 539.17

SCATTERING OF PROTONS FROM HELIUM AND LEVEL PARAMETERS IN Li^5. See Abstr. 3892

539.14 : 539.17

SCATTERING OF He^3 FROM He^4 AND STATES IN Be^7. See Abstr. 3901

539.14 : 539.166

EXCITED STATES OF Sn^{116}. See Abstr. 3873

539.14

4982. STUDY OF NUCLEAR ISOMERS OF In^{116} FORMED BY RADIATIVE CAPTURE OF SLOW NEUTRONS.
P.C.Capron and A.Vander Stricht.
Ann. Soc. Sci. Bruxelles I, Vol. 71, No. 3, 204-13 (1957). In French.

The formation of the isomers of In^{116} following radiative capture of slow neutrons was investigated with a view to testing whether these states are formed from one or from several levels of the compound nucleus. The activities from the two isomers were measured with a Geiger–Muller counter. Corrections were made for the difference in energy of the β-rays they emit, the thickness of the sample, and backscattering. Indium samples were irradiated in paraffin wax at different distances from a Ra–Be source. The ratio of activities as a function of distance had a small but definite dependence on neutron energy. This was confirmed by calculations of the mean quadratic migration distance of the neutrons, and by measurements of their absorption in boron. It is concluded that several levels of the compound nucleus are involved The half lives of the two states were found to be 14.5 ± 0.4 sec and 55.13 ± 0.27 min.

A.Ashmore

539.14

4983. ISOMERS IN Tb^{158} AND Ho^{163}.
N.B.Gove, R.W.Henry, L.T.Dillman and R.A.Becker.
Phys. Rev., Vol. 112, No. 2, 489-91 (Oct. 15, 1958).

The isomeric transition in Tb^{158}, with 10.5 sec half-life and 111 keV transition energy, is designated M3. The isomeric transition in Ho^{163}, with 0.8 sec half-life and 299 keV transition energy, is designated E3.

539.14

4984. ABSENCE OF ISOMERISM IN GALLIUM-65.
D.L.Morrison and N.T.Porile.
Phys. Rev., Vol. 113, No. 1, 289-90 (Jan. 1, 1959).

The formation of Ga^{65} was investigated in the decay of Ge^{65} and in the following reactions over a wide range of bombarding energies: $Cu^{63}(\alpha,2n)$, $Zn^{64}(\alpha p2n)$, $Zn^{64}(d,n)$ and $Zn^{64}(p,\gamma)$. In no case was a previously reported 8-minute isomer detected.

539.14

4985. OBSERVATIONS OF DIRECTIONAL CORRELATION IN Ag^{110m}(270 d). U.Cappeller, E.Ganssauge and W.Ullrich.
Z. Naturforsch., Vol. 13a, No. 7, 559 (July, 1958). In German.

Experimental observations lead to an understanding of the multipole character of the radiation emitted in this transmission.

J.M.Hough

539.14

4986. POSSIBLE EXPLANATION OF HYPERFRAGMENT SUPPRESSION IN K^-–d REACTIONS. T.B.Day and G.A.Snow.

Phys. Rev. Letters, Vol. 2, No. 2, 59-61 (Jan. 15, 1959).

Pais and Treiman have estimated the probability of formation of a bound (Σ^-,n) system by capture of K^- in d (Abstr. 299/1958). It is pointed out that they did not include consideration of absorption from the 2P atomic orbit via s-wave capture by the proton. This process is estimated to be about 10 times as probable as either the 2P-1S radiative transition or p-wave capture. Formation of bound (Σ^-,n) is then shown to be one order of magnitude less probable for this process than for the processes considered by Pais and Treiman. P.G.Murphy

539.14 : 536.48

4987. CONDITIONS OF SUPERFLUIDITY OF NUCLEAR MATTER. V.G.Soloviev.

Nuovo Cimento, Vol. 10, No. 6, 1022-31 (Dec. 16, 1958).

Assuming that nuclear forces are "weak", the author considers the conditions they must satisfy for nuclear matter to show the mathematical phenomena which it has been suggested is responsible for superconductivity, namely that the part of the two-body interaction which interacts between pairs of total momentum zero should give an energy shift proportional to the volume. The conditions found are roughly equivalent to the requirement that the potential should be attractive at the Fermi surface. The method is not applicable to nuclear matter if there is a hard core in the nuclear potential, but a plausibility argument is given for this case,and this leads to the conclusion that conventional nuclear forces do satisfy the required conditions. E.J.Squires

RADIOACTIVITY

539.16.08

4988. EFFECT OF DOSEMETER SIZE ON MEASUREMENTS CLOSE TO A RADIOACTIVE SOURCE. D.B.Dove.

Brit. J. Radiol., Vol. 32, 202-4 (March, 1959).

The use of dosemeters in regions where dose-rate varies appreciably across the dimensions of the dosemeter leads to inaccuracy in the "point" dose-rate indicated. Calculation shows that the error introduced is much less than the variation in dose-rate across the dosemeter might suggest.

539.16.08 : 539.1.07

4989. SCINTILLATION COUNTING IN EXPERIMENTS ON PARITY CONSERVATION. R.W.Hayward and D.D.Hoppes.

I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 161-6 (Dec., 1958).

A general review of the applications of scintillation counting to the measurement of certain dynamical quantities in weak interactions. These quantities include the momentum and angular distribution of emission with respect to nuclear polarization direction of beta particles from polarized nuclei, the longitudinal polarization of these beta particles, the circular polarization and angular distribution of gamma rays following the beta decay process, and any correlations of these quantities with one another or with the nuclear recoil. Particular emphasis is placed on the scintillation spectroscopy of beta particles performed within the vacuum space of a cryostat where the temperature of the detector is of the order of 0.01°K and where high magnetic fields are present.

539.162

4990. DECAY OF Np^{241}. R.Vandenbosch.

Phys. Rev., Vol. 113, No. 1, 259-60 (Jan. 1, 1959).

The decay of a 16 min neptunium activity attributed to Np^{241} was studied with anthracene and sodium iodide scintillation counters. The principal mode of decay appears to be a beta group decaying to the ground state of Pu^{241} with a beta end-point energy of 1.36 ± 0.10 MeV.

539.163

4991. DISINTEGRATION OF IRON-52 AND IRON-53. J.O.Juliano, C.W.Kocher, T.D.Nainan and A.C.G.Mitchell.

Phys. Rev., Vol. 1, No. 113, No. 2, 602-8 (Jan. 15, 1959).

The disintegration of Fe^{52} (8.2 hr) and Fe^{53} (8.9 min) was investigated with the help of scintillation and coincidence counting equipment. Fe^{52} decays 56.5% by positron emission and 43.5% by electron capture. The end-point energy of the positron group is 0.804 ± 0.01 MeV. This is followed by a gamma-ray of energy 165 keV leading to Mn^{52m} (21 min). The chain $Fe^{52} \rightarrow Mn^{52} \rightarrow Cr^{52}$ was studied. In addition to the well-known states of Mn^{52} — the ground state, with character 6+ and half-life of 5.7 days, and the first excited state (Mn^{52m}), with character 2+, half-life of 21 min, and energ of 390 keV — these experiments show a third excited state at 555 keV having a configuration 0+ and a half-life of $(1.2 \pm 0.2) \times \times 10^{-8}$ sec. The disintegration of Fe^{53} is accompanied by the emission of a gamma-ray of energy 380 keV and positron groups of end-point energies 2.84 ± 0.10, 2.38 ± 0.10 MeV, and an indication of third group at 1.57 ± 0.15 MeV.

539.16

4992. SCINTILLATION STUDIES OF SOME NEUTRON DEFICIENT ISOTOPES OF LUTECIUM.

L.T.Dillman, R.W.Henry, N.B.Gove and R.A.Becker.

Phys. Rev., Vol. 113, No. 2, 635-40 (Jan.15, 1959).

Lu^{170}, Lu^{172}, Lu^{173}, and Lu^{174} activities were produced by bombarding Lu_2O_3 with bremsstrahlung from betatrons. Gamma-rays of energy 0.083, 0.190, 0.245, and 2.04 MeV were associated with the decay of Lu^{170}. A gamma–gamma coincidence experiment showed that the 2.04 MeV gamma-ray was coincident with the three low-energy transitions. Gamma-rays of energy 0.079, 0.113, 0.181 0.203, 0.325, 0.370, 0.525, 0.820, 0.900, and 1.09 MeV were associated with the electron capture decay of 6.7-day Lu^{172}, the isotope studied in the most detail. Levels of energy 0.0787, 0.2602, 0.3731, 0.5769, 0.9015, 1.082, and 1.99 MeV above the ground state are assigned to Yb^{172} by gamma–gamma coincidence measurements and energy considerations. Gamma-rays of energy 0.022, 0.079, 0.113 0.145, 0.176, 0.274, 0.335, 0.440, 0.550, and 0.640 MeV were assign to transitions between levels of Yb^{173} while gamma-rays of energy 0.077, 0.084, 0.113, 0.176, 0.230, 0.275, 0.990, and 1.245 MeV were associated with the decay of Lu^{174}. A summary of all gamma–gamm coincidence experiments involving Lu^{173} and Lu^{174} is included. The 0.084 MeV transition associated with the decay of Lu^{174} was interpreted to be the first excited level of Hf^{174}. A rough calculation of the K-conversion coefficient of this transition yielded $\alpha_K \leq 2.5$.

539.163 : 539.17

HALF-LIVES OF F^{18} AND In^{114m}. See Abstr. 3915

539.163.1

4993. LOW-TEMPERATURE INFLUENCE ON THE TECHNETIUM-99 m LIFETIME. D.H.Byers and R.Stump.

Phys. Rev., Vol. 112, No. 1, 77-9 (Oct. 1, 1958).

The rate of decay of a nuclear isomer has been demonstrated to be influenced by its electronic environment. This effect has been utilized to detect environmental changes of Tc^{99m} in its metallic lattice at low temperatures. The effect of low temperature on the decay constant of Tc^{99m} in technetium metal was measured. Measurements were made at 77°K and 4.2°K. Since the metal is superconducting at 4.2°K, a measurement was made at 4.2°K in a magnetic field sufficient to destroy superconductivity. Results of the experiments indicate a negligible change in the decay constant for the metal at 77°K, whereas a noticeable change in the decay constant was observed for the superconducting metal at 4.2°K:

$$\lambda(4.2^\circ\text{K superconducting}) - \lambda(293^\circ\text{K}) = (6.4 \pm 0.4) \times 10^{-4}\lambda(293^\circ\text{K}).$$

Measurements on the low-temperature normal-state metal indicate a gross removal of this influence:

$$\lambda(4.2^\circ\text{K normal}) - \lambda(293^\circ\text{K}) = (1.3 \pm 0.4) \times 10^{-4}\lambda(293^\circ\text{K}).$$

539.163.2

4994. LEVEL SCHEME OF ${}_{75}Re^{187}$. M.Vergnes.

J. Phys. Radium, Vol. 19, No. 12, 947-56 (Dec., 1958). In French.

The disintegration: $W^{187} \rightarrow Re^{187}$ was studied by β-spectrometry, γ-spectrometry, and β–γ and γ–γ slow and fast coincidences. Transitions of: 72, 134, 206(?), 480, 552, 630, 686, 775, 866 keV were found, corresponding to excited levels of: 134, 206, 630, 686, 775, 866 (or 1000) keV. The 206 keV level, of half-life 5×10^{-7} sec, is de-excited to the 134 keV level by a 72 keV transition, identified as being E1 (hindrance factor: $F = 3.5\ (\pm 1.5) \times 10^{6}$). Spins and parities are assigned for most of the levels. A level scheme is proposed based on these experimental results.

539.163.2

4995. DECAY OF Ca^{39}. O.C.Kistner and B.M.Rustad.

Phys. Rev., Vol. 112, No. 6, 1972-5 (Dec. 15, 1958).

The "doubly closed shell ± one nucleon" mirror transition, $Ca^{39}(\beta^+)K^{39}$, was investigated in order to obtain a more precise ft value. The beta spectrum was measured with a magnetic, thin-lens spectrometer and has a maximum energy of 5.490 ± 0.025 MeV. A search for gamma rays was made with a NaI(Tl) scintillation spectrometer, and an upper limit of 0.12% was placed on transitions to the lowest known excited levels in K^{39} between 2.5 and 3.5 MeV. A half-life of 0.88 ± 0.01 sec was determined. The ft value calculated from these results if 4320 ± 100 sec.

539.163.2

4996. DECAY SCHEMES OF Sm^{145} AND Pm^{145}.

A.R.Brosi, B.H.Ketelle, H.C.Thomas and R.J.Kerr.
Phys. Rev., Vol. 113, No. 1, 239-46 (Jan. 1, 1959).

The electron capture decay schemes of Sm^{145} and Pm^{145} were investigated. The total disintegration energy of Sm^{145} was found to be 645 ± 15 keV by measurement of the inner bremsstrahlung energy end point. The fraction of electron captures to the 61 keV level that are K-electron captures was computed to be 0.83 ± 0.02 from conversion electron—X-ray coincidence counting rates. The same coincidence method gave 0.54 ± 0.02 as the K-electron capture fraction in Pm^{145} decay to the 67 keV level in Nd^{145}. From the experimental capture ratio the transition energy was computed to be 73 ± 10 keV. The lifetime of the 61 keV level in Pm^{145} was found to be 2.6×10^{-9} sec and that of the 67 keV level in Nd^{145} was found to be 3.3×10^{-8} sec. Conversion coefficients of the gamma rays emitted in Sm^{145} and Pm^{145} decay were measured. Energy level schemes which have spin and parity assignments consistent with the experimental measurements are proposed for both isotopes.

539.163.2

4997. DISINTEGRATION SCHEME OF Zn^{65}. G.I.Gleason.

Phys. Rev., Vol. 113, No. 1, 287-8 (Jan. 1, 1959).

Spectroscopic-coincidence techniques were employed to re-examine the electron capture rate, branching ratio, and positron rate of Zn^{65}. Decay by positron emission occurs to the extent of (1.70 ± 0.10)%. Electron capture to the excited state was found to be associated with (51.3 ± 3.0)% of the disintegrations, significantly higher than the (44-46)% reported in previous investigations.

539.163.2

4998. DECAY OF THE RADIOISOTOPES Ge^{68} AND Ga^{68}.

D.J.Horen.
Phys. Rev., Vol. 113, No. 2, 572-8 (Jan. 15, 1959).

The decays of Ge^{68} (275 days) and Ga^{68} (68 minute) were reinvestigated with single and coincidence scintillation spectrometers. Comparison of the gamma-ray singles spectra of the two radioisotopes indicates that Ge^{68} decays only to the ground state of Ga^{68} by electron capture. In addition to the known annihilation quanta and a gamma ray of 1.07 MeV in the decay of Ga^{68}, gamma rays of 0.81 ± 0.02, 1.24 ± 0.02, and 1.88 ± 0.02 MeV are observed. A level scheme of Zn^{68} with levels at 1.07, 1.88 and 2.31 MeV is proposed and is compared with level schemes of neighbouring even-even nuclei.

539.163.2

4999. DISINTEGRATION OF I^{124} AND I^{123}.

A.C.G.Mitchell, J.O.Juliano, C.B.Creager and C.W.Kocher.
Phys. Rev., Vol. 113, No. 2, 628-33 (Jan. 15, 1959).

The disintegration of I^{124}(4.2 days) was studied with the help of magnetic spectrometers and scintillation spectrometers. The disintegration occurs 71% by electron capture and 29% by positron emission. Three positron groups were found having end-point energies of 2130 (46.0%), 1531 (46.4%), and 786 (7.5%) keV. The most energetic positron group has a shape characteristic of $\Delta I = \pm 2$, yes. Positron—gamma coincidence experiments show that this group goes to the ground state. Gamma-rays of energies 2700, 2300, 2100, 1700, 1520, 1350, 723, and 603 keV together with annihilation radiation and Te K X-rays were found and the relative intensities measured. A disintegration scheme, consistent with the levels of T^{124} as determined from the decay of Sb^{124}, is established. No beta-rays were found, showing that a transition to Xe^{124} is highly improbable. The former work on I^{123}(13.5 hours) has been substantiated and, in addition, it seems highly unlikely that any positrons are emitted from I^{123}.

539.165

5000. ON THE L-AUGER LINES IN THE BETA-RAY SPECTRUM OF THE ACTIVE DEPOSIT OF THORON.

Z.Sujkowski and H.Slätis.
Ark. Fys., Vol. 14, Paper 8, 101-21 (1958).

The spectrum of L-Auger electrons in the β-spectrum of a Th(B+C+C'+C") source was measured, using a 45-gauss permanent magnet spectrometer. 54 lines with 6.135-15.574 keV were observed. 13 were interpreted as Auger lines in Tl^{208} and 34 were interpreted as Auger lines in Bi^{212}. The influence of nuclear recoil and Coster—Kronig transitions on line intensities and broadening are discussed. The spectrum is compared with previous work.

P.G.Murphy

539.165

5001. THE K—LL AUGER SPECTRUM OF $_{94}$Pu^{239}

G.T.Ewan, J.S.Geiger, R.L.Graham and D.R.MacKenzie.
Canad. J. Phys., Vol. 37, No. 2, 174-82 (Feb., 1959).

The K—LL Auger spectrum of Pu^{239} was examined using a high resolution $\pi\sqrt{2}$ β-ray spectrometer with a proportional counter detector. Seven lines were observed in the Auger spectrum with the following energies and relative intensities.

Energy (keV)	75.18 ±0.015	76.05 ±0.015	76.78 ±0.04	80.24 ±0.015	80.40 ±0.06	81.06 ±0.015	85.30 ±0.015
Relative intensity	1.0	1.86 ±0.10	0.11 ±0.04	0.60 ±0.06	0.05 ±0.03	1.11 ±0.07	0.40 ±0.05

The presence of seven lines in this K—LL Auger spectrum is in disagreement with theoretical predictions based on pure j—j coupling and supports, rather, the recent theoretical treatment of Asaad and Burhop. The energies of the observed lines are in satisfactory agreement with their theoretical predictions but discrepancies exist in the relative intensities.

539.165

5002. STUDY OF INTERNAL BREMSSTRAHLUNG, OF AUTO-IONIZATION AND OF ELECTRONS EMITTED SIMULTANEOUSLY WITH β-RAYS BY PHOSPHORUS 32. I. F.Suzor and G.Charpak.

J. Phys. Radium, Vol. 20, No. 1, 25-30 (Jan., 1959). In French.

By analysis of the coincident impulses in two proportional counters, a study was made of the low energy photon and electron spectrum (1 keV to 25 keV) emitted simultaneously with beta-rays by P^{32}. The photon spectrum comprises a 2.3 keV K-line following autoionization of the residual atom,of intensity 5.5×10^{-4} per disintegration, and the internal bremsstrahlung continuous spectrum; the latter agrees perfectly with the theoretical prediction from 1 keV to 6 keV and then it rises strongly above the theoretical values. The electron spectrum comprises the 2 keV Auger line and an important continuous spectrum. The intensity of the latter is higher than predicted by autoionization theory. The discrepancy becomes considerable from 5 keV to 25 keV where 6.6×10^{-3} associated electrons are found per disintegration.

539.165

5003. STUDY OF INTERNAL BREMSSTRAHLUNG, OF AUTO-IONIZATION AND OF ELECTRONS EMITTED SIMULTANEOUSLY WITH β-RAYS BY SULPHUR 35. II. G.Charpak and F.Suzor.

J. Phys. Radium, Vol. 20, No. 1, 31-4 (Jan., 1959). In French.

By analysis of the coincident impulses in two proportional counters,a study was made of the low energy photon and electron spectrum (1 keV to 20 keV) emitted simultaneously with beta-rays by S^{35}. The photon spectrum comprises 2.7 keV K-line following autoionization of the residual atom, of intensity 1.8×10^{-4} per disintegration and the internal bremsstrahlung continuous spectrum of intensity of the same order of magnitude as predicted by theory, from 4 keV to 10 keV. The electron spectrum comprises the Auger line of about 2 keV and a continuous spectrum which, as in P^{32}, although with smaller intensity, is much higher than predicted by autoionization theory. From 5 keV to 20 keV 3.6×10^{-3} associated electrons are found per disintegration.

539.165

5004. ON THE COUPLING CONSTANTS IN β-DECAY.

A.Kofoed-Hansen and A.Winther.
K. Danske Vidensk. Selsk. Mat.-fys. Medd., Vol. 30, Paper 20, 12 pp. (1956).

Recent experimental data on superallowed β-transitions are used in a redetermination of the β-decay coupling constants. It is suggested that the β-decay interaction may contain an admixture of vector coupling besides the usually adopted scalar and tensor interactions.

539.165

5005. INNER BETA SPECTRA OF Ag^{111} AND Rb^{86}.

R.L.Robinson and L.M.Langer.
Phys. Rev., Vol. 112, No. 2, 481-5 (Oct. 15, 1958).

The relatively high comparative half-lives of the low-energy, inner beta-ray group of Ag^{111} and the inner group of Rb^{86} suggest that their spectra may have nonstatistical shapes. The spectra were investigated with a 4π beta-ray scintillation spectrometer which had been adapted for beta-gamma coincidence studies. Both spectra are found to exhibit nonstatistical shapes.

539.165

5006. SEARCH FOR A $0^- \rightarrow 0^+$ PAIR TRANSITION IN O^{16}.

K.E.Eklund and R.D.Bent.

Phys. Rev., Vol. 112, No. 2, 488-9 (Oct. 15, 1958).

A search was made for an electron–positron pair transition from the 10.98 MeV 0^- state of O^{16} to the 0^+ ground state using the $F^{19}(p,\alpha)O^{16*}$ reaction and an intermediate-image pair spectrometer. No 10.98 MeV pairs were observed with an intensity as great as 2×10^{-5} that of the 3.86 MeV M1 cascade gamma-ray from the 10.98 MeV to the 7.12 MeV 1^- state. This result suggests a lower limit of $\tau > 2 \times 10^{-8}$ sec for the partial lifetime of a 10.98 MeV $0^- \rightarrow 0^+$ pair transition.

539.165

5007. SHAPE OF THE Pr^{143} BETA SPECTRUM.

J.H.Hamilton, L.M.Langer, R.L.Robinson and W.G.Smith.

Phys. Rev., Vol. 112, No. 3, 945-50 (Nov. 1, 1958).

Small deviations from the statistical shape which has previously been reported for Pr^{143} might be expected from a theoretical prediction for such a once-forbidden nonunique transition. The spectrum was investigated with greater precision and in greater detail than in past studies, with magnetic and scintillation spectrometers. The spectrum is found to exhibit small deviations from a statistical shape. The spectrum can be fitted with a once-forbidden, nonunique shape factor.

539.165

5008. POLARIZATION OF RaE ELECTRONS.

H.Wegener, H.Bienlein and H.v.Issendorff.

Phys. Rev. Letters, Vol. 1, No. 12, 460-1 (Dec. 15, 1958).

The longitudinal polarization of RaE electrons was measured by Mott scattering at energies of 120, 155, 209 and 290 keV. The corresponding values of $P/(-v/c)$ are 0.69 ± 0.04, 0.75 ± 0.04, 0.75 ± 0.04 and 0.66 ± 0.06. These values are briefly discussed.

M.A.Grace

539.165

5009. ELECTRON POLARIZATION IN THE β-DECAY OF RaE.

W.Bühring and J.Heintze.

Z. Phys., Vol. 153, No. 2, 237-46 (1958). In German.

A combination of multiple and single scattering technique with Cu and Pt foils is employed to measure the polarization, P, of electrons from the first forbidden transition ($1^- \rightarrow 0^+$) of RaE, with respect to Tl^{204} and Y^{91}. Assuming an electron energy distribution ($v/c \cong 0.8$), a mean value of $[P/(v/c)]$ is obtained; $[P/(v/c)] = 0.83 \pm 0.02$. The result is discussed in the light of the two-component theory and it is shown that by suitable choice of two real parameters an explanation of both the polarization and the spectrum is possible.

S.J.St-Lorant

539.165

5010. ELECTRON–NEUTRINO ANGULAR CORRELATION IN THE BETA DECAY OF NEON-23.

R.L.Burman, W.B.Herrmannsfeldt, J.S.Allen and T.H.Braid.

Phys. Rev. Letters, Vol. 2, No. 1, 9-11 (Jan. 1, 1959).

The spectrum of recoil atoms following the Gamow–Teller type β-decay of Ne^{23} was measured and leads to a value for the electron–neutrino angular correlation coefficient of −0.37 ± 0.04. This result shows the β-decay interaction to be predominantly axial-vector.

M.A.Grace

539.165

5011. ON THE DOUBLE β-DECAY OF Ca^{48}.

V.B.Belyaev and B.N.Zakhar'ev.

Zh. eksper. teor. Fiz., Vol. 34, No. 2, 505-6 (1958). In Russian. English summary: PB 141052T-1, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The probability of β-decay with the emission of two neutrinos was calculated by the authors using a shell model approximation. A nuclear decay which is suitable for this calculation is Ca^{48}–Ti^{48}, the transition being considered to occur via a virtual state of Sc^{48}. These three nuclei have the same core, Ca^{40}, which does not take part in the process, thus simplifying the calculations. The half-life of the process so obtained is about 10^{19} yr, if it is assumed that the decay can also pass through excited intermediate states. A correction factor to the shell model is still to be included, but for even–even nuclei, as in the present case, this should be small.

A.E.I. Research Laboratory

539.165

5012. β-SPECTRUM OF F^{20} AND F^{17}.

S.S.Vasil'ev and L.Ya.Shavtvalov.

Zh. eksper. teor. Fiz., Vol. 36, No. 1, 317-18 (1959). In Russian.

For F^{20}, the β-spectrum is in agreement with previous results (Abstr. 9558/1954). But in the case of F^{17} there are indications of a complex spectrum.

J.Lasco

539.16

5013. RECOIL EFFECT IN BETA DECAY AND K CAPTURE.

C.C.Bouchiat.

Phys. Rev., Vol. 112, No. 3, 877-89 (Nov. 1, 1958).

The study is extended to the case of forbidden transitions. Formulae for the angular distribution of recoil nuclei from oriente parent nuclei, the polarization of the recoil nucleus, and the angula correlation between the recoil nucleus and the following γ-ray emitted in given state of circular polarization are presented. For β-decay the results, in which the Coulomb effects have been taken into account only through the Fermi function, are given in closed form for n-forbidden transitions. The ST and VA interactions are considered separately. The results are quite sensitive to the choic between the two couplings. In particular, it is shown that for the so-called unique forbidden transitions of light-nuclei parity-non-conserving effects vanish for a VA interaction, whereas they are expected to be large with an ST interaction. The study of recoil effects in K-capture, which has been limited to the case of first forbidden transitions, provides a set of experiments which may be used to determine the helicity of the neutrino.

539.165

5014. ANGULAR CORRELATION BETWEEN NEUTRINO AND GAMMA QUANTUM RELEASED BY ELECTRON CAPTURE.

K.Nagy and J.Zimanyi.

Nuclear Phys., Vol. 9, No. 2, 329-33 (Dec. 1, 1958).

The density matrices for K-capture and nuclear gamma emissic are given. They are combined to give the ν–γ correlation function for angle and neutrino and photon polarizations for all orders of forbiddenness of the K-capture and mixed γ-transitions. The photo circular polarization must be measured as well as the angular correlation to determine the neutrino helicity.

P.G.Murphy

539.165 : 539.166

5015. β–γ CORRELATIONS IN THE FIRST FORBIDDEN TRANS-ITION. T.Kotani and M.Ross.

Phys. Rev., Vol. 113, No. 2, 622-7 (Jan. 15, 1959).

A discussion is given of the theory of β–γ correlations in the unique and nonunique first forbidden transition. In particular, numerical results are presented for the Coulomb corrections to the β–γ directional correlation and transverse β polarization–γ correlation. The energy dependence of the contribution associated with violation of time-reversal invariance is given.

539.165.08

5016. BETA DECAY OF Be^{11}. D.H.Wilkinson and D.E.Alburger.

Phys. Rev., Vol. 113, No. 2, 563-71 (Jan. 15, 1959).

Be^{11} was made in the reaction $B^{11}(n,p)Be^{11}$ and its radiations were studied with plastic and NaI(Tl) scintillation spectrometers both singly and in coincidence. The half-life as determined from measurements on both beta rays and gamma rays is 13.57 ± 0.15 sec. Decay takes place by beta-ray emission to the ground state of B^{11} (61%, $\log ft = 6.77$, $\beta_{max} = 11.48$ MeV), to the 2.14 MeV first excited state (29%, $\log ft = 6.63$), to the 6.76–6.81 MeV doublet (6.5%, $\log ft = 5.93$) and to the 7.99 MeV level (4.1%, $\log ft = 5.53$). Limits are set on the decay to several other levels, particularly those at 4.46 and 5.03 MeV (≤ 0.2%). Gamma rays of 2.121, 4.64, 5.86, 6.76 and 7.97 MeV are observed both singly and in coincidence with beta ray branches. An energy separation Be^{11}–$B^{11} = 11.48 \pm 0.15$ MeV is derived from the various beta and gamma ray energy measurements. It is concluded that the assignment $J = \frac{1}{2}$- for Be^{11}, as expected from the shell model, is possible but cannot be established firmly on the basis of the present evidence.

539.165.08

5017. POLARIZATION CORRELATION MEASUREMENTS ON Na^{24}. T.Mayer-Kuckuk and R.Nierhaus.

Z. Phys., Vol. 154, No. 3, 383-8 (1959). In German.

An arrangement for the measurement of angular correlations between β-particles and circular polarized γ-radiation is described and results for Na^{24} are given. A correlation coefficient A = = (+0.12 ± 0.03) was obtained, which indicates a ratio of Gamow–Teller to Fermi matrix element $M_G/M_F > 10$.

539.165.2

5018. ANTI-PROTON SCHEME OF β-DISINTEGRATION.

L.David.

Czech. J. Phys., Vol. 6, No. 6, 595-8 (Dec., 1956).

Considers the possibility of generalizing known schemes of β-decay by means of the antiproton reaction.

539.165.2

5019. SUPPLEMENT TO ANTI-PROTON SCHEME OF β-DISINTEGRATION. L.David.
Czech. J. Phys., Vol. 7, No. 3, 282-3 (1957).

See preceding abstract. The possibility of extending the known scheme of β-disintegration by four other anti-proton variants is rendered more exact by distinguishing between the neutrino and the antineutrino.

539.165.2

5020. DOUBLE BETA DECAY. H.Primakoff and S.P.Rosen.
Rep. Progr. Phys., Vol. 22, 121-66 (1959).

The phenomenon of double beta decay is discussed rather fully both from the experimental and from the theoretical point of view, the relation between double beta decay and the possible kinds of inverse beta decay being also briefly treated. A summary of the avail-experimental data is given, all methods of detection of the various double deta decay processes being considered. The theory of double beta decay, both in the no-neutrino and in the two-neutrino cases, is worked out, ab initio, on the basis of a nucleon—lepton interaction without conservation of parity. It is particularly emphasized that, with a "two-component neutrino" type nucleon—lepton without conservation of parity, absence of no-neutrino $\beta\beta$ decay does not by itself uniquely imply that neutrino and antineutrino are distinguishable and that the total lepton charge is conserved. Comparison of the experimental limits on the double beta decay half-lives with the corresponding theoretical values indicates that two neutrinos are emitted together with two electrons in each double beta decay process — this conclusion is, however, not yet certain and must be confirmed by further experimental work. A treatment is given of the implications of the actual occurrence of two-neutrino rather than no-neutrino double beta decay for the problems of neutrino—antineutrino identity and conservation of total lepton charge. It is concluded, on the basis of (i) the available double beta decay, inverse beta decay and muon decay experimental data and (ii) the provisional assumption of the universal applicability of "two-component neutrino" type coupling, that a verdict may be tentatively reached in favour of a "Dirac" neutrino, operationally distinguishable from a "Dirac" antineutrino, and with conservation of total lepton charge valid in all neutrino interactions.

539.166

5021. GAMMA-RAY SCATTERING BY NUCLEAR FLUORESCENCE OF Se^{75}. HALF-LIVES OF THE 265 AND 402 keV LEVELS OF As^{75}. H.Langevin-Joliot and M.Langevin.
J. Phys. Radium, Vol. 19, No. 10, 765-75 (Oct., 1958). In French.

Nuclear resonance fluorescence from the 265 keV excited state of As^{75} leads to a value of $2.3 \pm 0.3 \times 10^{-11}$ sec for the half-life of this level. No resonance fluorescence from the 402 keV level was observed and the half-life of this level is therefore greater than 1.4×10^{-11} sec. The variation of nuclear resonance intensity from the 265 keV level with the pressure of the gaseous source gives the value $(1.5 \pm 0.4) \times 10^{-9}$ sec for the half-life of the 402 keV level. Electron capture branching ratios have been re-examined and a weak (0.04%) new transition observed near the 575 keV level of As^{75}.

539.166

5022. NUCLEAR RESONANCE ABSORPTION OF GAMMA RAYS IN Ir^{191}. R.L.Mössbauer.
Naturwissenschaften, Vol. 45, No. 22, 538-9 (1958). In German.

The 129 keV transition in Ir^{191} is excited, using a centrifuge to compensate for the loss of energy of the γ-ray in the recoil. The width of the line is found to be 6.5×10^{-6} eV. G.E.Brown

539.166

5023. GAMMA RADIATION FROM ^{63}Zn.
R.W.Hayward, E.Farrelly-Pessoa, D.D.Hoppes and R.van Lieshout.
Nuovo Cimento, Vol. 11, No. 2, 153-5 (Jan. 16, 1959).

In the decay of 38 min Zn^{63} γ-rays are emitted with the following energies: 0.67, 0.96, 1.44, (2.0?), 2.35, 2.55 and 2.75 MeV. There is no 0.29 MeV transition. The 0.67 and 0.96 MeV γ-rays are only strongly coincident with the annihilation radiation, not with each other.

539.166

5024. THE GAMMA RAY SPECTRUM OF ^{63}Zn.
R.A.Ricci, R.K.Girgis and R.van Lieshout.
Nuovo Cimento, Vol. 11, No. 2, 156-66 (Jan. 16, 1959).

The spectrum was measured with scintillation techniques and a complete quantitative analysis was performed. The γ-rays found are reported with their relative intensities and compared with the levels found in Cu^{63} by the inelastic proton scattering experiment reported by Mazari, Buechner and de Figueiredo. The main features of the proposed partial decay scheme of Zn^{63} are discussed.

539.166

5025. MEASUREMENTS ON THE ν/c DEPENDENCE OF THE BETA-CIRCULARLY POLARIZED GAMMA CORRELATION IN Co^{60} USING A MAGNETIC-LENS SPECTROMETER.
L.A.Page, B.G.Pettersson and T.Lindqvist.
Phys. Rev., Vol. 112, No. 3, 893-6 (Nov. 1, 1958).

Measurements were made of the circular polarization of Co^{60} gamma-rays in coincidence with beta-rays whose momentum is defined by a magnetic lens spectrometer. The gamma-rays were analysed by a transmission-type Compton analyser of new construction (toroidal geometry). At nominal 180° between beta and gamma, and accepting both of the gamma-ray lines, the degree of circular polarization is generally higher than the expected +0.33 ν/c and markedly so for the smaller speeds. Proceeding downward in ν/c from 0.71 to 0.33 there is no indication that the polarization falls off as fast as would be given by a "ν/c-law".

539.166

5026. ANALYSIS OF GAMMA RAY SCINTILLATION SPECTRA FOR QUANTITATIVE PHOTON INTENSITIES. N.H.Lazar.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 138-46 (Dec., 1958).

The various considerations necessary for conversion of the pulse height spectrum from NaI(T1) spectrometers to photon intensity distributions are discussed. Some of these are: (1) resolution and efficiency of the crystal; (2) summing of cascade gamma rays; (3) source geometry and self-absorption; and (4) handling of positron emitters. A straightforward empirical method for subtracting the Compton distributions associated with the various gamma rays in a complex spectrum is indicated and the logical extension to continuous photon distributions is discussed.

539.166

5027. UNSCRAMBLING OF GAMMA-RAY SCINTILLATION SPECTROMETER PULSE-HEIGHT DISTRIBUTIONS.
J.H.Hubbell and N.E.Scofield.
I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 156-8 (Dec., 1958).

Describes the construction of a matrix expressing the response of a large sodium iodide crystal to axially incident 0.01 to 8 MeV gamma-rays. Interpolation from measured and calculated pulse-height distributions due to monoergic sources yielded a series of distributions at source-energy intervals uniform in the square root of energy. Each distribution was normalized to the total detection efficiency of the crystal and divided into "bins" whose centres were spaced at the above source-energy intervals. Integrated values of the contents of all such bins were written as a triangular matrix. Inversion of this matrix was performed on an automatic computer. Reduction of an experimental pulse-height distribution to a spectrum is effected by first expressing the distribution as a series of bin contents as above, then multiplying this series by the inverse response matrix, and finally dividing by bin widths to give photons per MeV.

539.166.83

5028. A CONTRIBUTION TO THE STUDY OF INTERNAL CONVERSION IN THE L-SUBSHELLS USING A SEMI-CIRCULAR MAGNETIC SPECTROGRAPH WITH PRE- AND POST-ACCELERATION. J.Delesalle.
J. Rech. Cent. Nat. Rech. Sci., No. 41, 237-50 (Dec., 1957).
In French.

To check hypotheses used in calculating the internal conversion coefficients and obtain information on nuclear structure, experimental measurements on the $L_I/L_{II}/L_{III}$ ratios to a precision of 3-4% are required. Semi-circular permanent magnetic spectrographs capable of this precision are described. The electrons were accelerated immediately before entering the magnetic field and again before reaching the photographic plate in order to intensify the lines, which were measured by a microphotometer. L_I, L_{II} and L_{III} ratios were measured for the ionium—radium transition and values obtained which were in agreement with theoretical values calculated by Rose et al. A.E.I. Research Laboratory

539.166.83

5029. THE INTERNAL CONVERSION SPECTRA FROM THE DECAY OF ^{197}Hg^{m}. I.J.van Heerden, D.Reitmann and H.Schneider.
Nuovo Cimento, Vol. 11, No. 2, 167-77 (Jan. 16, 1959).

The relative intensities of a number of internal conversion lines in the decay of Hg^{197} were determined rather accurately and compared with theoretical values. In general the agreement with static finite size corrected values is very good. It is found, however, that the theoretical M-shell coefficients are too large by about 40% in the cases studied. This is attributed to the neglect of the screening effect in the calculations. For the well-known 77.5 keV (M1 + E2) transition in Au^{197} the mixing ratio was found to be (9.4 ± 0.9)% E2, and the corrections which have to be applied to the point-nucleus coefficients for M1 conversion in the L_{I} and L_{II} shells are 0.75 ± 0.11 and $0.80^{+0.29}_{-0.24}$ respectively. These corrections are exactly those found if the "static" finite nuclear size effect is taken into account, and therefore indicate the absence of any structure dependent ("dynamic") effect in this case.

539.167

5030. PREPARATION OF NEW SOLUTION STANDARDS OF RADIUM.

W.B.Mann, L.L.Stockmann, W.J.Youden, A.Schwebel, P.A.Mullen and S.B.Garfinkel.

J. Res. Nat. Bur. Stand., Vol. 62, No. 1, 21-6 (Jan., 1959).

New radium-solution standards have been prepared in the ranges of 10 μg and also 10^{-9} and 10^{-11} g of radium element. These have been compared with the National Bureau of Standard's 1940 and 1947 series of radium-solution standards and, as a result of these comparisons, it has been found that the 1940 10^{-9} and 10^{-11} g solution standards contained some 2 to 3 per cent more radium element than certified. It has been shown that this difference probably arose in the dilution of the 1940 standards.

539.167

5031. NEW GERMANIUM ISOTOPE, Ge^{65}. N.T.Porile.

Phys. Rev., Vol. 112, No. 6, 1954-8 (Dec. 15, 1958).

A new germanium isotope, Ge^{65}, was produced by the (α,3n) reaction on Zn^{64}. The mass assignment was established through cross-bombardments, "milking" experiments, and excitation function measurements. The half-life of Ge^{65} is 1.5 ± 0.2 min. It decays by positron emission to 14 min Ga^{65}. The ground-state transition occurs in over 90% of the disintegrations and has a positron end-point energy of 3.7 ± 0.4 MeV and a log (ft) value of 4.8. Gamma-rays of 0.67 and 1.72 MeV have been observed with intensities of $0.03/\beta^{+}$ and $0.02/\beta^{+}$, respectively.

NUCLEAR REACTIONS

539.17

5032. SEMICLASSICAL TREATMENT OF DIRECT NUCLEAR REACTIONS. S.T.Butler, N.Austern and C.Pearson.

Phys. Rev., Vol. 112, No. 4, 1127-38 (Nov. 15, 1958).

A semiclassical method is employed to discuss the angular distributions of direct nuclear reactions. The method considers the incident and outgoing particles to be described by rays which follow classical paths; these rays can be refracted, reflected, and absorbed by a "clouded-crystal-ball" nucleus. Any given incident ray is considered to have a certain probability of suffering a major "scattering" at each point within a nucleus, this "scattering" not only changing the direction of the ray but also its wavelength. A condition of angular momentum conservation is imposed on this direct-scattering event, such that the angular momentum change in this process is equal to that required by the direct reaction under consideration. On this picture it is seen that the oscillations in the angular distributions which often occur with direct reactions arise as a result of interference between direct scatterings in different regions of the nucleus. Thus these oscillations are to be likened to the interference maxima and minima which arise when light is scattered, for example from a soap film. Effects due to compound nucleus absorption and of refraction and reflection of the incident and outgoing rays can be discussed fairly simply on this model. An investigation of the basis of the semiclassical method indicates that it should be reliable over a wide range of interesting conditions.

539.17

5033. TIME REVERSAL IN NUCLEAR INTERACTIONS.

E.M.Henley and B.A.Jacobsohn.

Phys. Rev., Vol. 113, No. 1, 225-33 (Jan. 1, 1959).

The limitations imposed by time-reversal invariance of nuclear forces have been examined for nuclear reactions, elastic double scattering (polarization) experiments, and angular correlations of gamma rays emitted from unoriented nuclei. For each of these, certain experiments have been found (which may superficially appear to be sensitive tests of time-reversal invariance) that are actually completely or partially insensitive to this symmetry. For example, in certain cases, the unitarity of the S matrix is sufficient to assure detailed balance. Such insensitivity to time-reversal invariance operates in some of the experimentally best-investigated problems. Those experiments which may be expected to be sensitive tests yield an upper limit of about 10% for that fraction of the Hamiltonia which is odd with respect to a time inversion. Experiments have been suggested which may lower this limit. (See also following abstract).

539.17 : 539.1

5034. GAMMA-RAY ANGULAR CORRELATION TESTS FOR TIME-REVERSAL INVARIANCE IN NUCLEAR FORCES.

B.A.Jacobsohn and E.M.Henley.

Phys. Rev., Vol. 113, No. 1, 234-8 (Jan. 1, 1959).

A systematic method for constructing tests of time-reversal invariance (see preceding abstract) in nuclear forces by means of gamma-ray angular correlations is described. The transition supplying the test consists of a mixed multipole; it must be preceded by a polarizer to produce a nuclear orientation and (in all but one case) followed by a second photon which serves as an analyser of the final nuclear orientation. The exception is a test in which one detects the linear polarization and direction of a quantum from a nucleus with initial orientation of third degree. A general formula for the direction of a single photon with arbitrary polarization and involving an arbitrary orientation of both the initial and final nuclear states is presented. Expressions of this type have the advantage that individual ones can be combined together in a simple way to form an arbitrary correlation formula. This is carried through numerically in one case for beta-gamma-gamma direction correlation, where the first photon is mixed E2 and M1. It is shown that such measurements must be carried out to 1 or 2% in order to better the present limit of the knowledge concerning time-reversal invariance.

539.17

5035. EXPERIMENTAL STUDY OF HIGH ENERGY INTERACTIONS IN PHOTOGRAPHIC EMULSION. J.Combe.

Ann. Phys. (Paris), Ser. 13, Vol. 3, No. 7-8, 468-509 (July-Aug., 1958). In French.

Results are given for the energy distribution and angular distribution of protons produced from stars in photographic emulsion bombarded by 340 MeV protons, and also by neutrons in the same energy region. The distributions are different for light and heavy nuclei. A Monte-Carlo calculation, using a mechanical device based on the Goldberger method for nucleon—nucleus collisions, gives results in agreement with observations for heavy nuclei. To explain the results for light nuclei the existence of substructures (e.g. α particles) is presumed and found to offer an adequate explanation.

A.Ashmore

539.17

5036. FURTHER STUDIES OF ANOMALOUS INELASTIC PROTON SCATTERING. B.L.Cohen and A.G.Rubin.

Phys. Rev., Vol. 111, No. 6, 1568-77 (Sept. 15, 1958).

Anomalous inelastic proton scattering (see Abstr. 4714/1957) was studied by (1) determining its dependence on bombarding energy (2) measuring the energy distributions with greatly improved energy resolution, (3) extending the data to separated isotopes and to elements not previously investigated because of target preparation difficulties, and (4) observing the energy distribution of the de-excitation gamma rays following the reaction. In (1), the anomalous peak is found to stay at the same Q value as the bombarding energy is varied. This indicates that the effect is not due to a giant resonance effect but rather, to the regular occurrence of a certain type of level in the final nucleus. In (2), many low-lying levels are resolved; a strong correlation is found between their cross-sections for excitation in these reactions and in Coulomb excitation, and an anti-correlation is found between their cross-sections for excitation in these reactions and in (p,d) reactions. This is interpreted as good evidence that the reactions used here strongly excite collective levels and only weakly excite single-particle transitions. The fine structures of the anomalous peaks differ greatly among neighbouring nuclides reflecting even-v.-odd and closed-shell effects; however, the gross structure as obtained with poor resolution is very similar for neighbouring elements. A few striking similarities between the spectra of several elements are pointed out. Several levels of known spin and parity are identified as contributing strongly to the anomalous peak. In (3), it is found that anomalous inelastic scattering ends by becoming irregular and weak between atomic numbers 54 and 64; it is apparently present in every isotope of every element between atomic numbers 30 and 53. In (4), gamma-ray transitions direct to the ground state following anomalous inelastic scattering are found to be relatively common. Many theoretical explanations for anomalous inelastic scattering are excluded by these results; there is reasonably good evidence that it arises from some type of collective excitation "dissolved" among many shell model states in that energy region.

539.17

5037. NUCLEON–SURFACE INTERACTION AND THE (P,N) REACTIONS. J.Sawicki and Z.Szymański.

Bul. Inst. Politeh. Iasi, Vol. 3(VII), No. 3-4, 53-60 (1957).

A correction to the direct neutron–proton interaction in $Si^{29}(p,n)P^{29}$ due to coupling of the nucleons via vibrational surface excitations has been calculated in the weak coupling approximation. Using square-well wave-functions the correction gives a small increase in the differential cross-section for 6 MeV protons.

P.G.Murphy

539.17 : 539.1.07 : 535.376

5038. INELASTIC NUCLEAR REACTIONS OF PROTONS IN SCINTILLATORS. L.H.Johnston, D.H.Service and D.A.Swenson.

I.R.E. Trans Nuclear Sci., Vol. NS-5, No. 3, 95-8 (Dec., 1958).

When a scintillation counter is used as a spectrometer for energetic protons, corrections must be made for the fact that (p,n) and other nuclear reactions may occur in the scintillator, causing some of the protons to register substandard pulse heights. These corrections were measured for thalliated sodium iodide, and for plastic scintillators at proton energies between 10 and 40 MeV, by measuring the pulse-height spectrum produced by a proton beam of homogeneous energy striking the crystal. The homogeneous beam is obtained by collimating a linear accelerator beam to $\frac{1}{8}$ in. diameter, then magnetically analysing to eliminate the slit-scattered protons.

539.17

5039. ELASTIC AND INELASTIC SCATTERING OF PROTONS BY N^{14}. J.W.Olness, J.Vorona, and H.W.Lewis.

Phys. Rev., Vol. 112, No. 2, 475-80 (Oct. 15, 1958).

Differential cross-sections for the elastic scattering of protons by N^{14} were measured for proton energies between 1.0 and 4.1 MeV at centre-of-mass scattering angles of 90.0° and 168.1°. Above 3.5 MeV the study was extended to four additional angles, 140.8°, 125.3°, 54.7°, and 39.2°, to provide information on a broad resonance near 3.9 MeV and a narrower resonance at 3.980 MeV. These two resonances also exhibit a measurable width for inelastic scattering to the first excited state of N^{14} at 2.31 MeV. All measurements were made with a differentially-pumped scattering chamber containing natural nitrogen gas. The probable error in the cross-section is estimated at 3%; the energies of the incident protons were determined to ±3 keV. The data were analysed to provide information on the resonance energies E_r and total widths Γ. Evidence was found for a previously unreported level with $E_r = 2.535$ MeV, $\Gamma \cong 1.8$ keV. From an investigation of the elastic and inelastic scattering data in the region of the level at 3.9 MeV it is concluded that the resonance is due to d-wave formation of a state of O^{15} having spin and parity $\frac{5}{2}^+$, with $E_r = 3.878 \pm 0.008$ MeV, $\Gamma = 85 \pm 8$ keV, $\Gamma_i = 7$ keV.

539.17

5040. ANGULAR DISTRIBUTIONS OF ELASTICALLY AND INELASTICALLY SCATTERED PROTONS FROM INDIUM.

R.D.Sharp and W.W.Buechner.

Phys. Rev., Vol. 112, No. 3, 897-902 (Nov. 1, 1958).

Thin targets of natural indium were bombarded with 7.04 MeV protons, and the scattered particles were analysed with a magnetic spectrograph. Inelastically scattered protons were observed corresponding to excited states in In^{115} at 1.078, 1.135, 1.292, and 1.982 MeV. Measurements were made on the variation of the absolute cross-sections for elastic and inelastic scattering, and it is concluded that a direct interaction process is important in the excitation of these states.

539.17

5041. INELASTIC PROTON SCATTERING IN MEDIUM-WEIGHT ELEMENTS. B.L.Cohen and A.G.Rubin.

Phys. Rev., Vol. 113, No. 2, 579-84 (Jan. 15, 1959).

Measurements were made of the energy distribution of emitted protons from nuclear reactions induced by protons of various energies between 11 and 23 MeV in elements of atomic number 22 to 30. At intermediate energies, the spectrum shows two maxima; there is strong evidence that the low-energy maximum is due either to "second protons", or to simultaneous emission of two particles. Measurements of nuclear temperatures at 18 MeV are strongly distorted by these effects. At lower bombarding energies, the low-energy contribution may be subtracted off, and distortion of the high-energy part of the spectra by direct ejection is not large, so that the statistical theory of nuclear reactions may be studied. Values obtained for the level density parameter a are independent of the energy of the emitted particle, independent of bombarding energy, slowly varying with atomic weight, and consistent with values obtained from neutron-induced reactions. But when these values are used to calculate cross-sections for (n,p) and (p,p') reactions, it is found that protons are emitted with excessive probability in the latter. Some possible explanations for this are discussed.

539.17

5042. MEASUREMENT AND ANALYSIS OF THE ANGULAR DISTRIBUTION AND EFFECTIVE CROSS-SECTION OF THE REACTION $F^{19}(p,\alpha_0)O^{16}$ IN THE ENERGY RANGE 0.4-0.72 MeV.

G.Breuer.

Z. Phys., Vol. 154, No. 3, 339-51 (1959). In German.

Total and differential cross-sections were studied at effective proton energies of 0.485, 0.55, 0.60, 0.64, 0.676 and 0.72 MeV. In this range of energy, the angular distribution shows a pronounced energy dependence. An analysis of the results made it possible to determine the state of the known resonance at 0.72 MeV. The existence of some weak broad resonances below 0.7 MeV was inferred from the angular distribution data. This is in agreement with earlier considerations of Gerjuoy [Phys. Rev., Vol. 58, No. 6, 503-5 (Sept. 15, 1940)].

539.17

5043. BREAKUP OF DEUTERONS BY PROTONS.

L.Cranberg and R.K.Smith.

Phys. Rev., Vol. 113, No. 2, 587-9 (Jan. 15, 1959).

Results are given for the neutron spectra at zero degrees from the reaction $p + d \rightarrow 2p + n$ for a range of incident proton energies from $E_p = 4.0$ to $E_p = 7.0$ MeV. Also given are the spectra as a function of angle for $E_p = 6.5$ MeV. The observed shapes show systematic discrepancies from those given by the theory of Frank and Gammel; these discrepancies increase with increasing proton energy although the reaction yield is accurately given by the theory.

539.17 : 539.14

NEUTRON THRESHOLDS IN THE $V^{51}(p,n)Cr^{51}$, $Mn^{55}(p,n)Fe^{55}$, $Zn^{70}(p,n)Ga^{70}$, AND $As^{75}(p,n)Se^{75}$ REACTIONS. See Abstr. 4981

539.17 : 539.14

5044. ENERGY SPECTRA OF THE α-PARTICLES ORIGINATED IN THE REACTION $C^{12}(d,\alpha)B^{10}$. I. EXCITED STATES OF B^{10}.

J.Catalá, A.Bonet and E.Villar.

An. Real Soc. Espan. Fis. Quim., Vol. 54(A), No. 9-10, 247-54 (Sept.-Oct., 1958). In Spanish.

Gaseous acetylene was bombarded with 19.17 MeV deuterons. The α-particles from the $C^{12}(d,\alpha)B^{10}$ reaction were studied in 14 nuclear plates at different angles. Tracks were observed corresponding to the following levels of B^{10} (all with isotopic spin T = 0): 0, 0.71, 2.14, 3.59, 4.73, 5.17, 5.65 and 6.15 MeV.

L.Pincherle

539.17

5045. ANGULAR DISTRIBUTIONS AND CORRELATIONS IN THE REACTION $B^{10}(d,p)B^{11}$.

S.Gorodetzky, M.Croissiaux, A.Gallmann, P.Fintz, J.Samuel and G.Frick.

C.R. Acad. Sci. (Paris), Vol. 248, No. 4, 550-3 (Jan. 26, 1959). In French.

The angular distributions of the protons associated with the 4.46 and 5.03 MeV levels in B^{11} from $B^{10}(d,p)B^{11}$ were measured at $E_d = 1.225$ MeV. The group going to the 4.46 MeV level appears to be partly explained by stripping with $l = 1$. The angular correlation between the γ-ray and the recoil nucleus was measured in the d–p plane and also in the plane perpendicular to the recoil direction. The angular correlations indicate $J = 1/2$ for the 4.46 MeV level and $J \neq 1/2$ for the 5.03 MeV level.

P.G.Murphy

539.17 : 539.14

5046. ANGULAR DISTRIBUTIONS OF THE NEUTRONS PRODUCED IN THE REACTION $Li^7(d,n)Be^8$.

J.Catalá, R.Font, F.Senent, J.Aguilar and M.de la Cuadra.

Nuovo Cimento Suppl., Vol. 9, No. 2, 377-80 (1958). In Spanish.

1500 tracks of recoil protons were examined in nuclear emulsions and the angular distributions were obtained for the neutron groups corresponding to the fundamental state of Be^8 and to the excited states at 1.34, 2.092 + 2.81 + 3.52, 4.20, 5.01, 5.91, 6.68 MeV.

L.Pincherle

539.17

5047. (d,p) REACTIONS IN THE Pb ISOTOPES AND THEIR INTERPRETATION.

M.T.McEllistrem, H.J.Martin, D.W.Miller and M.B.Sampson.

Phys. Rev., Vol. 111, No. 6, 1636-42 (Sept. 15, 1958).

Q values and differential cross-sections were measured for nuclear states excited by the $Pb^{206}(d,p)Pb^{207}$, $Pb^{207}(d,p)Pb^{208}$, and $Pb^{208}(d,p)Pb^{209}$ reactions. The known properties of the Pb^{206} ground state, low-lying states of Pb^{207}, and the Pb^{208} ground state are used to confirm the possibility of a stripping interpretation for these reactions. This interpretation is used to suggest possible assignments for the other observed states in Pb^{207} and Pb^{209}; in particular, the ground state of Pb^{209} is consistent with a $g_{9/2}$ assignment. The first excited state of Pb^{209} does not seem to behave like a single-particle state.

539.17

5048. ELASTIC SCATTERING OF 21.6 MeV DEUTERONS. J.L.Yntema.
Phys. Rev., Vol. 113, No. 1, 261-7 (Jan. 1, 1959).

The absolute differential cross-section for the elastic scattering of 21.6 ± 0.2 MeV deuterons was measured for Mg, Ni, Cu, Zn, Rh, Ag, Pt and Au. The cross-sections were measured for each element with a two-degree interval between 10° and 42° and between 45° and 150° with a five-degree (or less) interval. The estimated standard deviation ranges from 3% in the forward direction to 6% in the backward direction. The deuterons were detected with a double NaI(Tl) crystal with an energy resolution of about 2%. In most cases the contribution of inelastically scattered deuterons to the cross-section is negligible. The ratio of measured cross-section to Rutherford cross-section shows a pronounced diffraction pattern in all cases.

539.17 : 539.14

ANALYSIS OF PROTONS FROM $Cu^{63,65}(d,p)Cu^{64,66}$ See Abstr. 4977

539.17 : 539.14

ANOMALOUS ANGULAR DISTRIBUTION IN $B^{10}(d,p)B^{11}$. See Abstr. 4980

539.17

5049. NUCLEAR REACTIONS INDUCED BY THE NITROGEN BOMBARDMENT OF SULFUR. D.E.Fisher, A.Zucker and A.Gropp.
Phys. Rev., Vol. 113, No. 2, 542-7 (Jan. 15, 1959).

Thick targets of ZnS, containing natural sulphur, were bombarded with 28 MeV nitrogen ions in the ORNL 63 in. cyclotron. The compound nucleus resulting from bombardment of S^{32} with 28 MeV nitrogen ions is V^{46}, with an excitation energy of 33.3 MeV. The following nuclear reactions were studied: (1) $S^{32}(N^{14},p)T^{45}$; (2) $S^{32}(N^{14},2p)Sc^{44}$; (3) $S^{32}(N^{14},2p)Sc^{44m}$; (4) $S^{32}(N^{14},2pn)Sc^{43}$; (5) $S^{32}(N^{14},2\alpha)K^{38m}$; and (6) $S^{32}(N^{14},N^{13})S^{33}$. The yields as a function of incident energy for these reactions were differentiated to obtain excitation functions. The cross-sections for (1), (2 and 3), and (5) are compared with calculations based on the statistical theory of compound nucleus decay. Two values of the level density parameter, a, were employed, first considering and then ignoring de-excitation of a nucleus by gamma-ray emission. The value a = A/10.5 fits the p and 2p emission cross-sections when gamma emission is considered. The excitation function for reaction (6) agrees well with the systematics of previously studied nitrogen-induced transfer reactions.

539.17

5050. NITROGEN-INDUCED NUCLEAR REACTIONS IN POTASSIUM. J.J.Pinajian and M.L.Halbert.
Phys. Rev., Vol. 113, No. 2, 589-94 (Jan. 15, 1959).

Excitation functions were measured for the production of Fe^{53}, Fe^{52}, Mn^{52}, Mn^{52m}, Mn^{51}, Cr^{49}, V^{48}, V^{47}, and Ti^{45} from the nitrogen bombardment of potassium in its normal isotopic mixture. The method used was activation of thick targets of KBr followed by chemical separations and absolute beta-counting. The cross-sections at 27.5 MeV range from 0.14 mb for Fe^{52} to 8.3 mb for Mn^{51}. The relation of the Mn^{52}:Cr^{49}:Fe^{52} ratio to the odd-even effect in the nuclear level density is discussed. The total cross-section for formation of the compound nucleus was estimated at several energies. The fraction of this total accounted for by one-particle emissions from the compound nucleus is surprisingly large.

539.17

5051. INELASTIC SCATTERING OF ELECTRONS FROM ^{6}Li AND ^{14}N. P.Cazzola and C.Foglia.
Nuovo Cimento, Vol. 10, No. 5, 913-15 (Dec. 1, 1958).

The scattering leading to the excitation of the 2.18 MeV state for Li^6 and 3.95 MeV state for N^{14} is calculated using the shell model both in LS and JJ coupling, following the treatment of Morpurgo (Abstr. 4633/1956). C.J.Batty

539.17 : 539.14

5052. HIGH-ENERGY ELECTRON SCATTERING AND THE CHARGE DISTRIBUTION OF CARBON-12 AND OXYGEN-16. H.F.Ehrenberg, R.Hofstadter, U.Meyer-Berkhout, D.G.Ravenhall and S.E.Sobottka.
Phys. Rev., Vol. 113, No. 2, 666-74 (Jan. 15, 1959).

The scattering of high-energy electrons from C^{12}, reported previously, was extended to 420 MeV. The elastic and inelastic scattering from the first excited level at 4.43 MeV has been studied between 33° and 70°. The new data are in good agreement with what one would expect from the earlier measurements on C^{12} performed at 187 MeV. Additional measurements of the elastic O^{16} scattering cross-sections of 240, 360, and 420 MeV electrons as functions of the scattering angle furnish information on the size and shape of the O^{16} nucleus. Pronounced diffraction minima in the angular distributions were observed for C^{12} and O^{16}. The experimental results are compared with the predictions of a theoretical phase-shift analysis derived for the harmonic-well independent-particle model of the nucleus. Preliminary best fits confirm the shell-model predictions for the charge density distribution of these p-shell nuclei. The preliminary analysis of the data shows that the length parameter of the well is 1.66×10^{-13} cm for C^{12}, and 1.76×10^{-13} cm for O^{16}, thus indicating a slight variation of the curvature of the harmonic well as the p shell is filled in.

539.17 : 539.14

5053. THE THEORY OF THE PHOTONUCLEAR REACTION USING THE INDEPENDENT PARTICLE MODEL OF THE NUCLEUS. S.Sueoka.
Canad. J. Phys., Vol. 37, No. 2, 232-43 (Feb., 1959).

For high-energy photonuclear reactions, particularly for the direct emission of a neutron, the integration of the matrix element of the interaction energy of the nucleus and the radiation field is carried out without the usual expansion in a series of multipoles. The method is applied to the O^{16}, O^{17} nuclei, with harmonic oscillator wave functions for the nucleus. The ratio of the cross-section obtained by the present method and that by considering only dipole absorption is found for various γ-rays energies.

539.17

5054. SPLITTING OF THE GIANT RESONANCE FOR DEFORMED NUCLEI. E.G.Fuller and M.S.Weiss.
Phys. Rev., Vol. 112, No. 2, 560-7 (Oct. 15, 1958).

Photoneutron yield measurements were made for terbium, tantalum, and gold with good energy resolution from threshold up to 25 MeV. Neutron-production cross-sections were obtained directly from the experimental points without smoothing the raw data. Corrections were made for the multiple production of neutrons above the $(\gamma,2n)$ thresholds. The giant resonances for terbium and tantalum were found to be split into two resonances as predicted by Okamoto and Danos. The giant resonances for all three nuclei were fitted by the superposition of two Lorentz shape resonance lines. The intrinsic quadrupole moments determined from these fits to the experimental data were: terbium, +5.6 ± 0.6 barns; tantalum, +5.7 ± 0.3 barns; and gold, +1.6 ± 0.6 barns.

539.17

5055. GAMMA-RAY ABSORPTION IN CARBON. M.M.Wolff and W.E.Stephens.
Phys. Rev., Vol. 112, No. 3, 890-2 (Nov. 1, 1958).

The total absorption of the gamma rays from the $T^3(p,\gamma)He^4$ reaction was measured as a function of proton energy and hence gamma-ray energy. As the gamma-ray energy was varied from 20.3 to 20.8 MeV, the total absorption cross-section in carbon varied smoothly from 315 ± 5 to 324 ± 6 millibarns. The resolution was better than 70 keV and the sensitivity sufficient to detect narrow resonances of more than 0.8 MeV—millibarns integrated cross-section, but no structure was observed although photonuclear resonances have been reported in this region.

539.17 : 530.145

5056. RELATIVISTIC K-SHELL PHOTOEFFECT. M.Gavrila.
Phys. Rev., Vol. 113, No. 2, 514-26 (Jan. 15, 1959).

Expressions for the relativistic K-shell photoeffect cross-sections, correct to first order in αZ (inclusive), are established. For this purpose a second order calculation must be carried out, that is, electronic spinors correct to second order in αZ must be employed in the matrix element. The final continuum state spinor of the electron, whose exact analytic form is not known, is described by means of the Born approximation. To avoid the divergences, peculiar to the application of this method to the pure Coulomb field, the case of the screened potential is considered at the beginning. The matrix element, which is evaluated in momentum space, remains singular in the limit of no screening. Nevertheless, it is shown that the differential cross-section, as issuing from a very laborious trace evaluation, is to first order finite in this limit and has the behaviour one would expect. Indeed, its zero-order approximation in αZ coincides with Sauter's formula, as it should. Further, in the nonrelativistic and extreem relativistic limits the cross-section determined reduces to results established by other means.

539.17

5057. MEASUREMENT OF THE RANGE OF RECOIL ATOMS.

R.A.Schmitt and R.A.Sharp.

Phys. Rev. Letters, Vol. 1, No. 12, 445-7 (Dec. 15, 1958).

Describes a new stacked-foil technique in which atoms which have recoiled out of a thin foil after photonuclear reactions are detected in interleaved Al "catcher" foils by their subsequent beta decay. Experimental ranges are given for various atoms from C to Au with energies in the range 9 keV to 130 keV, and agree reasonably well with those calculated by Nielsen's formula.

J.Hawgood

539.17

5058. ELASTIC SCATTERING OF PHOTONS BY TANTALUM.

E.G.Fuller and E.Hayward.

Phys. Rev. Letters, Vol. 1, No. 12, 465-7 (Dec. 15, 1958).

The differential elastic scattering cross-section for tantalum, at 120°, is measured and analysed as a function of the energy. It is found that the assumption that the nuclear dipole polarizability is a tensor gives a better fit than taking the polarizability as a scalar.

J.Lascoux

539.17

5059. POLARIZED NUCLEONS FROM THE PHOTODISINTEGRATION OF THE DEUTERON.

J.J.de Swart, W.Czyż and J.Sawicki.

Phys. Rev. Letters, Vol. 2, No. 2, 51-3 (Jan. 15, 1959).

The polarization of the nucleons in the photodisintegration of the deuteron is calculated for photon energies between 9.3 and 80.4 MeV. The Gartenhaus wave-function is used for the deuteron and the Signell—Marshak potential is used for the final state interactions.

P.G.Murphy

539.17

5060. PHOTOPROTONS FROM VANADIUM.

A.Halsteinslid, K.Nybø and R.B.Møllerud.

Univ. Bergen Arbok, No. 15, 9 pp. (1958).

The angular and energy distributions of protons from vanadium irradiated by 30 MeV bremsstrahlung were measured by means of nuclear emulsions. The energy distribution has a maximum at 4 MeV and a similar shape as previously found for medium heavy elements. The medium energy protons show a clear asymmetry in the forward direction.

539.17

5061. NUCLEAR ABSORPTION CROSS-SECTIONS FOR γ-RAYS BETWEEN 10 AND 30 MeV. B.Ziegler.

Z. Phys., Vol. 152, No. 5, 566-73 (1958). In German.

The bremsstrahlung spectrum of a 32 MeV betatron is measured using a pair spectrometer capable of yielding spectrum measurements behind absorbers with attenuation factors of up to 30 times. Data obtained from measurements on the beam with no absorbing material in position are multiplied by the known values for the absorption due to the Compton effect and pair-production and the curves brought into coincidence, outside the giant resonance region, with results measured on Au, Cu, Al, C, and water. Agreement appears good within the limits of accuracy of the method, except in the case of C where the integrated cross-section obtained is about $\frac{1}{3}$ of that calculated from the summed values of (γ,n), (γ,p) experiments. No reasons for the discrepancy are suggested.

S.J.St-Lorant

539.17

5062. DIFFERENTIAL CROSS SECTIONS FOR PHOTODISINTEGRATION OF THE DEUTERON AT FAR FORWARD AND BACKWARD ANGLES.

C.A.Tatro, T.R.Palfrey, Jr, R.M.Whaley and R.O.Haxby.

Phys. Rev., Vol. 112, No. 3, 932-5 (Nov. 1, 1958).

Direct measurements were made at centre-of-mass angles of 11°, 100°, and 176° using photons with energies near 200 MeV. The cross-sections at 176° were found to be 3.8 ± 0.6 μ barns/sterad and 5.2 ± 0.6 μ barns/sterad at a mean photon energy of 190 MeV and 238 MeV, respectively. These cross-sections are higher than would be predicted by extrapolation from the angular distributions measured by other workers. The cross-sections at the other two angles were in satisfactory agreement with previous measurements or extrapolations of measurements. The behaviour of the differential cross-sections at the far backward angle is taken as additional evidence of the close relation between photoproduction of mesons and photodisintegration of the deuteron in this energy region.

539.17

5063. AN OPTICAL MODEL FOR NEUTRON REACTION CROSS-SECTIONS. P.Mittelstaedt.

Z. Naturforsch., Vol. 12a, No. 8, 643-6 (1957). In German.

Hitherto it has not been possible to calculate σ_r and σ_e, the reaction and elastic scattering cross-sections respectively, for neutron reactions. It is therefore proposed to extend the existing optical model for neutron cross-sections by the introduction, on phenomenological grounds, of a second complex optical potential which would yield expressions for σ_r and σ_e in addition to the total cross-section σ_t. Such a potential possesses similar properties to the optical potential but excludes the compound-elastic decay modes. The relation between the two models is discussed on the basis of the physical interpretation of the optical model.

S.J.St-Lorant

539.17 : 539.14

5064. INELASTIC SCATTERING OF 14 MeV NEUTRONS BY CARBON. J.Vervier, J.Delfosse, J.Boxus and A.Martegani.

Bull. Acad. Roy. Belgique Cl. Sci., Vol. 42, No. 7, 784-9 (1956). In French.

The energy spectrum of the neutrons scattered at 20° to the incident beam was measured using photographic plates. Seven neutron groups were detected corresponding to the first seven excited states in C^{12}. The neutron spectrum is in satisfactory agreement with that calculated from previous information on the states in C^{12}, except with respect to two of the groups. In these cases the reported experimental results are stated to be open to doubt.

A.J.Salmon

539.17 : 539.16.08

5065. NEUTRON ACTIVATION CROSS SECTIONS AT 25 keV.

R.Booth, W.P.Ball and M.H.MacGregor.

Phys. Rev., Vol. 112, No. 1, 226-9 (Oct. 1, 1958).

Neutron activation cross-sections were measured at 25 keV for 31 isotopes. An Sb—Be photoneutron source was used, and thermal activations served to calibrate the beta- and gamma-detector efficiencies. The cross-sections were measured relative to iodine. A comparison was made between measured cross-sections and predictions based on known low-energy resonance parameters.

539.17

5066. NEUTRON NONELASTIC CROSS-SECTION MEASUREMENTS ON CARBON. M.H.MacGregor and R.Booth.

Phys. Rev., Vol. 112, No. 2, 486-7 (Oct. 15, 1958).

The cross-sections were measured over the energy range from 5.8 to 12.9 MeV. The main features of the cross-section as a function of neutron energy are a gradual rise from threshold (4.8 MeV) up to 7 MeV, a steep rise from 7 to 8 MeV, and an approximately constant value from 8 to 14 MeV. In the vicinity of sharp resonances in the total cross-section, good cross-section determinations are difficult to obtain using present-day sphere transmission techniques.

539.17 : 539.163

5067. TWO NEW PROMETHIUM ISOTOPES; CROSS SECTIONS OF SOME SAMARIUM ISOTOPES;FOR 14.8 MeV NEUTRONS.

R.G.Wille and R.W.Fink.

Phys. Rev., Vol. 112, No. 6, 1950-4 (Dec. 15, 1958).

When highly enriched samples of Sm^{152} and Sm^{154} were irradiated with 14.8 MeV neutrons, activities having half-lives of 6.5 ± 0.5 min and 2.5 ± 0.5 min were observed. On the basis of yields and cross-bombardments, these are assigned to new isotopes Pm^{152} and Pm^{154}, respectively. Cross-section measurements at 14.8 MeV for (n,2n), (n,p), and (n,α) reactions of samarium are reported, the experimental values being as follows: $Sm^{144}(n,2n)$, 1200 ± 300 mb; $Sm^{154}(n,2n)$, 1500 ± 300 mb; $Sm^{152}(n,p)$, 3.7 ± 0.2 mb; $Sm^{154}(n,p)$, 3.5 ± 0.2 mb; $Sm^{152}(n,\alpha)$, 10 ± 2 mb; and $Sm^{154}(n,\alpha)$, 9 ± 3 mb. While the (n,2n) cross-sections are within an order of magnitude agreement with statistical evaporation theory, the experimental values for the (n,p) and (n,α) cross-sections are several orders of magnitude larger than those calculated from statistical evaporation theory based on the compound nucleus model.

539.17

5068. (n,γ) CROSS SECTIONS OF Na^{23}, I^{127}, AND Au^{197}.

S.J.Bame,Jr and R.L.Cubitt.

Phys. Rev., Vol. 113, No. 1, 256-8 (Jan. 1, 1959).

The cross-sections for the $Na^{23}(n,\gamma)Na^{24}$ and the $I^{127}(n,\gamma)I^{128}$ reactions were measured by an activation method over the neutron energy range 20 keV to 1 MeV. The neutron flux was measured with a fission detector which contained a thin layer of known weight of U^{235}. The Na^{23} cross-section variation with energy shows incompletely resolved resonance structure; an average curve through the data decreases as $1/v_n$ from 2.4 mb at 20 keV to 0.6 mb at 300 keV, and as $1/E_n$ from 0.6 mb at 300 keV to 0.2 mb at 1 MeV. The I^{127} cross-section can be represented approximately by a straight line on a log-log plot, decreasing from 1.0 barn at 30 keV to 80 mb at 1 MeV. The $Au^{197}(n,\gamma)Au^{198}$ cross-section, measured at a neutron energy of 180 keV, is 310 ± 20 mb.

539.17

5069. INVESTIGATION OF THE ENERGY LEVEL AND THE CROSS-SECTION EFFECT OF SEVERAL (n,α) PROCESSES, CAUSED BY THERMAL NEUTRONS. F.Münnich.

Z. Phys., Vol. 153, No. 1, 106-23 (1958). In German.

To investigate the (n,α) reactions for elements of medium atomic number, photographic plates were prepared with salts of these elements. The plates were exposed (with and without boron shielding) to neutrons from a paraffin moderated Ra—Be source. Range measurements of the tracks in these plates gave the "Q-values" and cross-sections for the isotopes S^{32}, S^{33}, Ca^{40}, Ni^{58}, Ni^{61}. The results obtained are compared with theoretical predictions and the results of other workers. D.H.Lord

539.17 : 539.21

(n,α) REACTIONS IN BORON GLASS. See Abstr. 4044

539.17

5070. ELASTIC SCATTERING OF 150 MeV NEGATIVE PIONS BY NUCLEI. T.A.Fujii.

Phys. Rev., Vol. 113, No. 2, 695-709 (Jan. 15, 1959).

The elastic scattering of 150 MeV negative pions by complex nuclei was experimentally studied by the use of energy-sensitive Cherenkov detectors with a pulse-height analyser. The elastic scattering could be distinguished from inelastic processes within the 10 MeV resolution width of these detectors. The differential cross-sections of carbon, aluminium, copper, and lead were measured at angles between 18.5° and 43.6°. In addition, measurements on carbon and lead were extended to large angles between 45° and 139°. It was found that elastic scattering was confined predominantly to the forward angles less than 60°. Calculations based on the optical model with a square well were carried out to obtain the values of parameters which provided the best fit to the data. They are $-30\text{ MeV} \geq V_R \geq -40\text{ MeV}$, $-65\text{ MeV} \geq V_I \geq -75\text{ MeV}$, and $1.3 \times 10^{-13} A^{\frac{1}{3}}\text{cm} \leq R \leq 1.4 \times 10^{-13} A^{\frac{1}{3}}\text{cm}$, where V_R and V_I are real and imaginary parts of the potential, R is the nuclear radius, and A is the nuclear mass. The corresponding values of the reaction mean free path were of the order of the pion Compton wavelength. These values are close to those predicted by Frank, Gammel, and Watson from the knowledge of the pion—nucleon interaction.

539.17

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also the Section entitled "COSMIC RAYS".

539.17

5071. ANGULAR DISTRIBUTIONS IN FISSION INDUCED BY ALPHA PARTICLES, DEUTERONS AND PROTONS. C.T.Coffin and I.Halpern.

Phys. Rev., Vol. 112, No. 2, 536-43 (Oct. 15, 1958).

Protons of 11 MeV, deuterons of energies up to 22 MeV, and alpha-particles of energies up to 43 MeV were used to study fission fragment angular distributions in the following targets: Bi^{209}, Ra^{226} Th^{232}, U^{238}, U^{235}, Np^{237}, and Pu^{239}. All of the measured distributions were qualitatively similar in that more fragments were emitted forward and backward along the beam direction than sideways. The largest ratios of 0° to 90° differential cross-sections were slightly greater than 2 and were obtained in the alpha-particle bombardments. The smallest ratios occurred in the proton bombardments. If one decomposes the fissions observed at a given bombarding energy into symmetric and asymmetric mass components, the anisotropy for each component decreases smoothly as the value of Z^2/A ofthe compound nucleus increases. The asymmetric anisotropies are larger than the symmetric ones. There is no observable effect of the value of the target spin on the observed anisotropies. It is pointed out that some of the observed features of the anisotropies may be accounsted for in terms of the fact that some of the fissions occur only after the evaporation of neutrons.

539.17

5072. SLOW NEUTRON RESONANCES IN U^{235}. F.J.Shore and V.L.Sailor.

Phys. Rev., Vol. 112, No. 1, 191-202 (Oct. 1, 1958).

The total and fission cross-sections of U^{235} were measured in the energy range 0.1 to 10 eV on the BNL crystal spectrometer. The capture cross-section is derived by combining these data with published scattering cross-section data. Analysis of the low-energy resonance structure depends strongly on the interpretation of the "background" cross-section which dominates the low-energy region This "background" cannot be accounted for in terms of observed resonances; however, if it is attributed to the presence of a bound level, approximate parameters for such a level can be obtained. It seen that the strength $\Gamma_n{}^0$ of the hypothetical bound level is anomalously large. The capture component of the resonances is found to b symmetrical, i.e., of Breit—Wigner shape. However, the fission component of the same resonances is asymmetrical, which indicates that a multilevel formula is necessary for fitting the resonances in the fission cross-section. A good but not perfect fit to the data between 0 and 2 eV has been achieved using a multilevel formula which applies to the case of a single fission channel and many capture channels. The remaining small discrepancies in fitting the data indicate that the assumption of a single fission channel is too restrictive, and that one or more additional channels contribute weakly to slow neutron fission in U^{235}.

539.17

5073. RESONANCE THEORY OF NEUTRON CROSS SECTIONS OF FISSIONABLE NUCLEI. E.Vogt.

Phys. Rev., Vol. 112, No. 1, 203-14 (Oct. 1, 1958).

The general Wigner—Eisenbud resonance theory is used to deve op a method of analysis for the neutron cross-sections of fissionable nuclei. The method is employed in giving a reasonable description o the low-energy cross-sections in U^{235}. The single-level fit for U^{235} is known to be unreasonable. Many-level expressions for the cross-sections are derived — the only approximation to the general theory being the neglect of all but a small group of resonances. No explicit reference to fission channels is needed and the many-level expressions require few level parameters: the E_λ, $\Gamma_{\lambda n}$, $\Gamma_{\lambda\gamma}$, and $\Gamma_{\lambda f}$ of the single-level theory for each resonance and a few additional parameters pertinent to the interference between levels. The interference terms are described and shown to be important. Their average value yields information about the number of channels involves in fission. The shape and size of the U^{235} cross-sections below 2 eV ar fitted to within one or two per cent using: (a) only one negative energy resonance of smaller size than in the single-level fit; (b) no additional levels to fit the shape other than the observed levels at positive energies; (c) three interference parameters whose size suggests that there are several fission channels in U^{235}.

539.17

5074. FISSION NEUTRON SPECTRA AND NUCLEAR TEMPERATURES. J.Terrell.

Phys. Rev., Vol. 113, No. 2, 527-41 (Jan. 15, 1959).

It is shown that Weisskopf's nuclear evaporation theory, when allowance is made for the expected distribution of nuclear temperatures of fission fragments, predicts an essentially Maxwellian distribution of fission neutron energies in the laboratory system. This is found to be in excellent agreement with all available data. On the assumption that neutron emission is symmetrical about 90° in the centre-of-mass system, the average energy $\bar{E}$ of the fission neutron energy spectrum should be $\bar{E} = \bar{E}_f + 2\bar{T}$, in which $\bar{E}_f$ and $\bar{T}$ are the average values of the fission fragment energy per nucleon and the nuclear temperature. Experimentally, $\bar{E}_f \cong 0.78$ MeV for all cases reported, giving fission fragment nuclear temperatures of 0.6 to 0.7 MeV for measured fission neutron spectra. This gives $a = 12 \pm 2\text{ MeV}^{-1}$ for the equation $E_e = aT^2$ = excitation energy. The same concepts lead to the prediction $\bar{T} \cong \frac{2}{3}[(\bar{\nu} + 1)E_0/2a]^{1/2}$, or $\bar{E} \cong 0.78\text{ MeV} + 0.621\ (\bar{\nu} + 1)^{1/2}$ for U^{235} + n; E_0 is the excitation energy change per emitted neutron, about 6.7 MeV, and $\bar{\nu}$ is the average number of neutrons emitted per fission. This equation, which is approximately valid for all present experimental data, leads to the prediction that $d\bar{E}/dE_x \cong 0.025$ for U^{235} (E_x is the excitation energy of the fissioning nuclide). The centre-of-mass energy spectrum of fission neutrons has also been calculated, as well as effects of anisotropy of emission on the laboratory fission neutron spectrum.

539.17

5075. MEASUREMENT OF THE NEUTRON SPECTRA IN THE FISSION OF U^{233}, U^{235}, Pu^{239} WITHIN THE RANGE 50-700 keV. V.P.Kovalev.

Zh. eksper. teor. Fiz., Vol. 34, No. 2, 501-2 (1958). In Russian. English summary: PB 141052T-1, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The spectrum was determined from range measurements of recoil protons in a steam-filled Wilson cloud chamber. Uranium oxide and plutonium dioxide fission converters irradiated with a beam of thermal neutrons provided the fission neutrons. In this energy range the three spectra agree within 10-20% and are fitted by the equation:

$$F(E) \cong \exp(-E/T)\,\sinh(2\sqrt{\omega E}/T)$$

with $\omega = 0.5$ MeV, $T = 1$ MeV. The ratios of the number of protons between 0.05-0.6 MeV to the number above 0.6 MeV for U^{233}, U^{235}, Pu^{239} were determined to be 0.49 ± 0.4, 0.53 ± 0.04, 0.48 ± 0.04, indicating that the fission spectra do not differ markedly at higher energies. A.E.I. Research Laboratory

539.17 : 539.217

DIFFUSION OF FISSION-PRODUCED XENON IN URANIUM OXIDE. See Abstr. 4053

539.17 : 539.12

BETA SPECTRUM FROM THERMAL NEUTRON FISSION OF U^{235}. See Abstr. 4891

539.17

5076. DELAYED NEUTRONS FROM THE SPONTANEOUS FISSION OF Cf^{252}.

S.Cox, P.Fields, A.Friedman, R.Sjoblom and A.Smith.
Phys. Rev., Vol. 112, No. 3, 960-3 (Nov. 1, 1958).

The periods and absolute yields of delayed neutrons emitted were measured. Delayed-neutron periods of $\tau_{1/2} = 0.5 \pm 0.4$, 2.0 ± 0.4, and 20.0 ± 0.5 sec with respective absolute yields of 0.35, 0.29, and 0.22% were found. The experimental results have been correlated with delayed-neutron emission from other fission processes and with existing precursor systematics.

539.17

5077. HYDRODYNAMIC THEORY OF SPONTANEOUS FISSION.

W.D.Foland and R.D.Present.
Phys. Rev., Vol. 113, No. 2, 613-21 (Jan. 15, 1959).

The penetration factor for spontaneous fission is calculated from the liquid-drop model. The transformation of the Gamow integral over the nucleon coordinates into an integral over the deformation parameters a_n is carried out hydrodynamically, assuming irrotational motion. The transformation requires evaluation of the kinetic energy in terms of a_n and a_n. Series expansions are used for the kinetic energy and for the potential energy of deformation. All parameters but a_2 are neglected and the hydrodynamic calculations are carried through terms in a_2^4. While the potential barrier is subject to several uncertainties, it has nevertheless been possible to estimate the spontaneous fission hindrance factor for the highest Z elements. For $Z = 100$ and $Z^2/A \approx 39$ it is found that a 1 MeV increase in barrier height should correspond to a $10^{3.7}$-fold increase in the half-life. This result agrees closely with the empirical hindrance factor formula deduced by Swiatecki from a correlation of fluctuations in half-lives with deviations of ground-state masses from the semiempirical mass formula. Some details of both the hydrodynamic and the electrostatic calculations are included.

539.17

5078. THE SYSTEMATICS OF THE MEAN NUMBER OF INSTANTANEOUS FISSION NEUTRONS ν.

B.D.Kuz'minov and G.N.Smirenkin.
Zh. eksper. teor. Fiz., Vol. 34, No. 2, 503-4 (1958). In Russian.
English summary: PB 141052T-1, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

Curves of ν, the mean number of neutrons from spontaneous fission, as functions of A for different values of Z are compared with experimental values, agreement being obtained. Assuming binary fission with the heavier component being arbitrarily fixed at A = 140, the terms of the energy balance equation $E_f = E_k + \nu E_n + E_\gamma$ were evaluated by semi-empirical methods. Values of ν obtained were reduced to the value for spontaneous fission using the equation $d\nu/dE_n = 1/E_n$. A.E.I. Research Laboratory

539.17 : 621.387 : 621.039

5079. THE BASIC PHYSICS OF THERMONUCLEAR PROCESSES.

T.E.Allibone and D.R.Chick.
Proc. Instn Elect. Engrs, Paper 2888 [Convention on Thermonuclear Processes], publ. April, 1959, 9 pp. To be republished in Vol. 106A (1959).

States density and temperature requirements for which a radiation-cooled ionized plasma could yield a net power gain from fusion reactions in deuterium or deuterium-tritium mixtures. Containment of the plasma by electric or magnetic fields is shown to be essential, and the behaviour of the plasma in such fields is discussed. Magnetic mirror fields are discussed briefly, and an attempt is made to list the forms of wave motion which can occur in such a plasma. Some features of the self-pinched discharge are stated and the stability conditions for a possible model of such a pinched discharge are outlined. Attention is drawn to some experimental results tending to invalidate assumptions used in the theoretical formulation.

539.17

5080. THE ENERGY YIELD FROM DEUTERIUM–TRITIUM MIXTURES.

G.Boulègue, P.Chanson, R.Combe, M.Feix and P.Strasman.
C.R. Acad. Sci. (Paris), Vol. 247, No. 3, 284-6 (July 21, 1958).
In French.

The initial temperatures required in plasmas of deuterium and deuterium–tritium mixtures are such that the fusion energy is equal to the radiation loss, and consequently the reaction is self-sustaining, are calculated. It is found that small concentrations of tritium considerably depress the initial temperatures required. Even for an initially pure deuterium plasma the small concentration of tritium produced by the initial fusion reactions is sufficient to depress the critical temperature considerably. A pure deuterium plasma with a K+ value of 28 keV will first cool until sufficient tritium is formed and then will increase in temperature. Neglecting the formation of this small quantity of tritium the instantaneous "critical temperature" for a pure deuterium system would be given by Kt = 42.4 keV. Six per cent of tritium reduces the critical temperature to about 8 keV.
A.E.I. Research Laboratory

539.17 : 523.877

AN OBSERVATIONAL TEST OF THE CARBON-CYCLE RATE. See Abstr. 4236

539.17

5081. NUCLEAR PROCESSES IN URANIUM ORES.

W.Burkhardt.
Ann. Phys. (Leipzig), Vol. 20, No. 1-6, 184-209 (1957). In German.

The uranium ore deposits are considered as subcritical reactors. Then the existence of a high percentage of neutron-induced fissions and the Pu^{239} content of the ores can be explained. In addition, the unusual isotope-abundances can be explained partly by means of α-reactions, partly by non-nuclear physical arguments.
P.Roman

539.17 : 536.24.01

5082. THE [STEADY STATE] TEMPERATURE DISTRIBUTION IN A [HOMOGENEOUS] GAS COOLED REACTOR OF SPECIAL FORM. O.Hellman.

Ann. Acad. Sci. Fennicae A VI, No. 12, 8 pp. (1958).

539.17 : 536.423

CHANGE OF STATE OF THE COOLANT GAS IN REACTORS. See Abstr. 4520

539.17 : 539.1.07

APPLICATION OF SCINTILLATION COUNTERS TO REACTORS. See Abstr. 4864

539.17 : 621.039.6

5083. SCEPTRE III A. A.A.Ware.

Proc. Instn Elect. Engrs, Paper 2898 [Convention on Thermonuclear Processes], publ. April, 1959, 6 pp. To be republished in Vol. 106A (1959).

The toroidal discharge apparatus Sceptre III was modified and is now known as Sceptre III A; the modification included new magnetic-field coils and improved measurement facilities. The paper reviews the experimental results which were obtained with Sceptre III A. The evidence of many of the measurements suggest that the large electron-energy loss associated with this type of discharge is caused by an electron-particle loss to the tube walls. If this is correct, the observed Doppler broadening and Doppler shift of the ion spectral lines have simple explanations. A mechanism is suggested for the electron-particle loss.

539.17 : 537.525 : 621.387 : 621.039

5084. THE DESIGN AND PERFORMANCE OF ZETA.

E.P.Butt, R.Carruthers, J.T.D.Mitchell, R.S.Pease, P.C.Thonemann, M.A.Bird, J.Blears and E.R.Hartill.
Proc. Instn Elect. Engrs, Paper 2901 [Convention on Thermonuclear Processes], publ. April, 1959, 18 pp. To be republished in Vol. 106A (1959).

Describes the main design parameters of the pinched-ring discharge apparatus Zeta, the principal observations made with it during the period up to April 1958, and the deductions on the physical phenomena occurring in the hot gas. Discharge pulses of up to 200 kA have been passed through deuterium. The pinched current channel has a resistance of about 3 milliohms and an inductance of about 4 μH. The power input corresponds to the magnetically confined gas losing its kinetic thermal energy every 100 microsecond. Energies of tracer impurity ions measured spectroscopically correspond to temperatures of 5×10^6 deg K. Electron temperatures estimated from the resistance, microwave noise and spectroscopic intensities are in the range 1 – 5 × 10^5 deg K. The greater temperature of the ions could be due to macroscopic motion of the gas.

539.17 : 621.039

5085. A REVIEW OF WORK TOWARDS NUCLEAR ENERGY FROM CONTROLLED THERMONUCLEAR REACTION. D.W.Fry.
Proc. Instn Elect. Engrs, Paper 2903 [Convention on Thermonuclear Processes], publ. April, 1959, 9 pp. To be republished in Vol. 106A (1959).

539.17 : 537.525 : 658.57 : 621.039

5086. THE MODIFICATION OF ZETA IN 1958.
J.T.D.Mitchell, H.R.Whittle, E.M.Jackson and P.B.Clarke.
Proc. Instn Elect. Engrs, Paper 2930 [Convention on Thermonuclear Processes], publ. April, 1959, 7 pp. To be republished in Vol. 106A (1959).

Modifications have been carried out on Zeta to improve performance of the equipment in scientific and engineering aspects. These comprise installation of a stainless-steel bellows liner in the torus, ignitron switching and simplification of the pulse circuit, and improved vacuum pumping, stabilizing field and diagnostic facilities. The modified machine (Zeta IA) is now in operation.

539.17

5087. IS INDUSTRIAL FUSION FOR TOMORROW? G.Vendryes.
J. Phys. Radium, Vol. 19, No. 8-9, 724-31 (Aug.-Sept., 1958).
In French.

A lecture given in Paris, April 1958, during the French Physical Society Exhibition. The basic principles which underlie the possible use of fusion for producing power are described. The approach making use of the pinch effect is discussed in some detail.

539.17 : 533.59 : 621.039 : 621.387

VACUUM SYSTEM DESIGN IN ZETA I. See Abstr. 4358

539.17 : 537.525 : 621.039 : 621.387

PHYSICAL MEASUREMENTS ON HEAVY-CURRENT DISCHARGES. See Abstr. 4652

539.17 : 537.56

NEUTRON EMISSION OF HIGH CURRENT DEUTERIUM DISCHARGES. See Abstr. 4748

ATOMS

539.18/.19

5088. STUDY OF THE CORRELATIONS BETWEEN THE POSITIONS OF THE ELECTRONS. S. Odiot.
Cahiers de Phys., Vol. 11, 181-202 (May, 1957). In French.

These are the first two chapters of a thesis, the aim of which is to connect the quantum mechanical description of the correlations between the electrons in atoms or molecules with the more classical concepts used in quantum chemistry. The first chapter treats the effect of configuration interactions on the wave function of two electrons in a many-electron system, following Lennard-Jones and Pople. The second chapter considers the possibility of determining the effect of the correlation on experimental quantities, such as the ratio of L-capture to K-capture. J.Lascoux

539.18

5089. IONIZATION POTENTIALS OF THE ATOMS FROM Al TO K, Sc^+ TO Ca^+ AND P^{++} TO Sc^{++}. M.A.Catalán and F.R.Rico.
An. Real Soc. Espan. Fis. Quim., Vol. 54(A), No. 9-10, 289-300 (Sept.-Oct., 1958). In Spanish.

Regularities between the levels, terms and limits for the configurations $3p^{n-1}4s$ and $3p^{n-1}5s$ are discussed. Calculated positions of certain levels are as follows:

P I	5s $^4P_{0\frac{1}{2}}$	72 430	5s $^2P_{0\frac{1}{2}}$	73 000 cm^{-1}
Cl I		91 300		92 297
Cl III				246 640
K III	5s $^4P_{2\frac{1}{2}}$	288 900	5s $^2P_{1\frac{1}{2}}$	291 447

The following values of ionization potentials differ from those given by Moore (Atomic Energy Levels, Vol. III; Circ. Nat. Bur. Stand., No. 467, 1958) S III 34.79, Cl III 39.64, A III 40.70, K III 45.79, Ca III 50.88 eV. R.F.Barrow

539.18

5090. CALCULATIONS OF THE EXCITED STATES OF ATOMS.
Z.Horak.
Czech. J. Phys., Vol. 8, No. 3, 271-7 (1958).

The possibility of calculating the approximate wave-functions of the excited states of a many-electron atom by means of extremalization of the variation functional is discussed. The calculation of helium 1s2s ^1S and X-ray K-state of neon was carried out in this way assuming the wave-functions expressed in the analytical form. The results obtained are satisfactory compared with those obtained by other methods, including by experiment.

539.18

5091. ANGULAR MOMENTUM DISTRIBUTIONS FOR THE THOMAS—FERMI FIELD. T.Tietz.
Nuovo Cimento, Vol. 11, No. 1, 121-3 (Jan. 1, 1959).

Golden's expression for this (Abstr. 6353/1958) is evaluated analytically using the approximate T-F function of Tietz (Abstr. 3559/1957) and agrees well with Golden's numerical calculations and with experiment. J.Hawgood

539.18 : 523.161

5092. METASTABILITY OF 2s STATES OF HYDROGENIC ATOMS. J.Shapiro and G.Breit.
Phys. Rev., Vol. 113, No. 1, 179-81 (Jan. 1, 1959).

It was found by Breit and Teller that double photon emission is the principal cause of decay of interstellar hydrogen atoms from their metastable 2s state and the mean life corresponding to this decay was bracketed by them between upper and lower limits. In the present paper an account is given of a more accurate evaluation of the transition probability $A_T = (8.226 \pm 0.001)Z^6$ sec^{-1}, where Z is the atomic number. Relativistic effects on the atomic wave functions have been neglected in the calculations which are therefore accurate only for small Z.

539.18

5093. NUCLEAR STRUCTURE CORRECTION TO THE HYPERFINE STRUCTURE IN HYDROGEN. C.K.Iddings and P.M.Platzman.
Phys. Rev., Vol. 113, No. 1, 192-7 (Jan. 1, 1959).

In previous papers, corrections to the hyperfine structure (h.f.s.) in hydrogen of relative order $\alpha m/M$ have been calculated by treating the proton as a point particle with an anomalous magnetic moment in addition to its Dirac moment. In this paper the proton is treated as a particle with structure by making use of the high-energy electron—protons/scattering data. Corrections of the previous work in which only a point particle was considered are calculated by using the Feynman formulation of quantum electrodynamics. It is also shown that exactly the same terms may be obtained by using the covariant Bethe—Salpeter equation. The calculated shift of −40 parts per million (including the "recoil corrections") is not in agreement with the combined results of several experiments (−1.4 ± 18 parts per million). A possible source of this difference is meson corrections to a two-photon form-factor which is taken here as the product of two (Hofstadter) single-photon form-factors.

539.18

5094. DETERMINATION OF THE HYPERFINE STRUCTURE OF ATOMIC NITROGEN BY OPTICAL ORIENTATION.
W.W.Holloway,Jr and R.Novick.
Phys. Rev. Letters, Vol. 1, No. 10, 367-8 (Nov. 15, 1958).

The method of optical pumping, which only requires a small degree of dissociation of N_2, was used to study the Zeeman transitions ($\Delta F = 0$, $\Delta m_F = \pm 1$) between the hyperfine levels $F = \frac{5}{2}, \frac{3}{2}, \frac{1}{2}$ of the ground state of N^{14}. It was found that:

$$\nu_{5/2} - \nu_{3/2} = 26.1275 \pm 0.0005 \text{ Mc/s}$$

$$\nu_{3/2} - \nu_{1/2} = 15.6772 \pm 0.0005 \text{ Mc/s}$$

and that the hyperfine interaction constant is 10.4510 ± 0.0002 Mc/s $(\frac{5}{2} - \frac{3}{2})$ and 10.4515 ± 0.0003 Mc/s $(\frac{3}{2} - \frac{1}{2})$. R.W.Nicholls

539.18

5095. A NOTE ON THE SPIN—SPIN EFFECT IN THE HYDROGEN ATOM. K.Helmers.
Z. Phys., Vol. 154, No. 3, 310-11 (1959). In German.

The magnetic hyperfine structure of the hydrogen ground state is derived from non-relativistic quantum mechanics, and is thus shown to be not an essentially relativistic effect as it might appear from previous derivations.

539.18 : 539.2

ANALYTIC HARTREE—FOCK SOLUTIONS FOR $O^=$. See Abstr. 4037

539.18 : 523.852

THE RECOMBINATION SPECTRUM OF NEBULAR HYDROGEN. See Abstr. 4234

539.18

5096. MEASUREMENTS OF LIGHT MASSES WITH THE MASS SYNCHROMETER. L.G.Smith.
Phys. Rev., Vol. 111, No. 6, 1606-19 (Sept. 15, 1958).

Gives all results obtained with the mass synchrometer before Nov., 1957, including an extensive set of measurements on 40 parent ion doublets. From least squares analyses of 39 of these doublet values and of 11 selected earlier values and from three other earlier values are derived what are believed to be the best values obtainable from all synchrometer data of the mass excesses of the 14 nuclides from which all ions studied are composed. These are H^1, D^2, He^4, B^{10}, B^{11}, C^{12}, N^{14}, O^{16}, Ne^{20}, Ne^{22}, S^{32}, Cl^{35}, Cl^{37}, and A^{40}. Best values of all measured doublets are also tabulated. Statistical analyses indicate that, for external consistency of results, the internal errors given should be multiplied by either 2.35 or 3.6 (the larger fraction applying primarily in cases where ions are formed by molecular dissociation). They also indicate that, except in cases where ions are formed with appreciable kinetic energies, the external error of the mean of twenty measurements of a doublet separation made with present techniques is about one part in 4×10^7 of the mass number. The agreement of the best values with the latest comparable values obtained at the University of Minnesota is excellent for the important mass excess C–12 and satisfactory in nearly all other cases. Agreement with comparable values obtained from measurements of nuclear reaction energies is fairly good except for C_3–HCl^{35} and Cl^{35}–35, the synchrometer values of which appear to be in error.

539.18

5097. THE SEPARATION OF ISOTOPES IN AN ULTRACENTRIFUGE. A.Selecki.
Nukleonika, Vol. 4, No. 1, 13-33 (1959). In Polish.

Basic problems underlying the use of high-speed centrifuges are discussed. Particular consideration is given to recent advances in the design of ultracentrifuges. A general theoretical analysis of the operation of isotope separation by ultracentrifuging is outlined. Experimental results are reviewed.

539.18

5098. HIGH-SENSITIVITY MASS SPECTROMETRIC MEASUREMENT OF STABLE HELIUM AND ARGON ISOTOPES PRODUCED BY HIGH-ENERGY PROTONS IN IRON.
O.A.Schaeffer and J.Zähringer.
Phys. Rev., Vol. 113, No. 2, 674-8 (Jan. 15, 1959).

A high-sensitivity mass spectrometer was used to measure the helium, argon, and neon produced in iron by 0.16, 0.43, and 3.0 BeV protons. The spectrometer has a sensitivity so that 10^{-11} standard cc of helium could be detected above the contamination level. The He^4 cross-sections are 120 mb, 450 mb, and 1300 mb at 0.16, 0.43, and 3.0 BeV, respectively, while the He^3/He^4 cross-section ratios are, respectively, 0.09, 0.10, and 0.18. At 0.43 BeV, cross-sections of 1.0 mb, 3.3 mb, 8 mb, and 4.1 mb were found for the argon isotopes 36, 37, 38, and 39, respectively. The cross-section for Ne^{21} is 0.1 mb at 0.43 BeV. The results are discussed in relation to evaporation theory and the rare gas content of iron meteorites. The He^3 yields are all higher than previously measured tritium values. At 3 BeV the He^3/T ratio is 2.4. It is suggested that in the case of iron in evaporation theory the Coulomb barrier is not as important relatively as previously thought. Alternatively, a large fraction of the He^3 and tritium may be produced during the nuclear cascade which precedes the evaporation from the excited nuclei. The cross-sections measured bear directly on the cosmic-ray-produced rare gases in meteorites. From the cross-section of directly produced He^3 relative to T, previous measurements of He^3-T exposure ages of iron meteorites must be reduced by a factor of about 3. From the argon isotope cross-sections it is seen that 80% of the Ar^{36} in meteorites is the result of β decay of cosmic-ray-produced Cl^{36} and thus Ar^{36}–Cl^{36} should be a reliable method for measuring exposure ages of meteorites.

539.18 : 537.311.31

5099. THE ISOTOPE EFFECT IN THE FLOW OF CURRENT IN MOLTEN LITHIUM METAL. A.Lundén, A.Lodding and W.Fischer.
Z. Naturforsch., Vol. 12a, No. 3, 268-9 (1957). In German.

A direct current (current density $0.7450\ A/cm^2$) passed through molten lithium metal contained in a stainless steel capillary tube (0.7 mm i.d., wall thickness 0.15 mm, length 20 cm) produced a slight enrichment of the light isotope at the anode end. The whole cell was maintained at 300 ± 10° C in an oil bath. The specific resistance of molten lithium at this temperature was found to be $(33 \pm 2) \times 10^{-6}$ cm. After 159 hr operation the cell was cooled and divided into five samples. The mass effect μ was $(3.4 \pm 0.6) \times 10^{-5}$.

H.C.Cole

539.18 : 537.531

5100. ATOMIC SCATTERING FACTORS FOR SPHERICAL AND ASPHERICAL CHARGE DISTRIBUTIONS. A.J.Freeman.
Acta cryst., Vol. 12, Pt 4, 261-71 (April, 1959).

The atomic scattering factors for forty-five atoms and ions are calculated from Hartree and Hartree–Fock SCF (self-consistent field) wave-functions and compared with the results of James and Brindley, Berghuis et al. Principal scattering factors were also calculated along the lines of McWeeney for a number of atoms containing aspherical charge distributions of p-electrons. A general formalism for calculating the coherent scattering of X-rays from non-spherical charge distributions as a function of atomic orientation is presented, based in part on group theoretic methods. For p-electrons the results of McWeeny are reproduced. For d-electrons, the scattering is completely described in terms of three principal scattering factors and the angle between the scattering vector and the atomic orientation. As an illustration, specific numerical calculations are given for several atoms with incomplete d-shells. A discussion of the relationship between this treatment and the usual spherical approximation is presented.

539.18 : 537.531

5101. AN ATOMIC SCATTERING FACTOR FOR IRON.
A.J.Freeman and J.H.Wood.
Acta cryst., Vol. 12, Pt 4, 271-3 (April, 1959).

An atomic scattering factor for iron is calculated using self-consistent field wave-functions as calculated by the unrestricted Hartree–Fock method in which Slater's average exchange potential formulation was used to simplify the variational problem. As this results in separate sets of radial wave-functions for the two one-electron spin directions, individual one-electron form factors have also been calculated from which neutron scattering functions may be calculated. Comparison is made with the results of Viervoll and Ögrim (1949) and those obtained from the Thomas–Fermi method, with and without exchange.

539.18

5102. SCATTERING POWER OF ATOMS FOR X-RAYS AND ELECTRONS ACCORDING TO THE STATISTICAL THEORY OF THE ATOM. T.Tietz.
Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 1-2, 41-5 (1958).
In German.

Derives closed, approximate formulae for the intensity of incoherent X-ray and electron scattering from a neutral atom on the basis of the Thomas–Fermi model of an atom. Presents a table of comparison of numerical values with those directly computed by Bewilogua (Physikalische Zeitschrift, Vol. 32, 740, 1931).

B.Meltzer

539.18

5103. CALCULATION OF THE DIFFERENTIAL CROSS-SECTION FOR THE SCATTERING OF MEDIUM-VELOCITY ELECTRONS AT ATOMS FROM HARTREE FUNCTIONS. H.Wyrwich and F.Lenz.
Z. Naturforsch., Vol. 13a, No. 7, 515-23 (July, 1958). In German.

The differential cross-section for elastic and inelastic scattering is related to the distribution of screening electrons; the individual contributions of these are estimated by means of Hartree functions and presented graphically in terms of a dimensionless parameter depending on scattering direction. Asymptotic procedures are given for extreme cases.

A.E.I. Research Laboratory

539.18

5104. INTERACTION ENERGY AND MOBILITY OF Li^+ IONS IN HELIUM. E.A.Mason, H.W.Schamp, Jr and J.T.Vanderslice.
Phys. Rev., Vol. 112, No. 2, 445-8 (Oct. 15, 1958).

The interaction energy of Li^+ and He is calculated for a range of internuclear separations. The results are not in very good agreement with a similar calculation by Meyerott (Abstr. 985/1945), who used the same wave-functions but approximated many of the molecular integrals. Considerable uncertainty is caused by lack of knowledge of the second-order exchange energy. The results are used to calculate the mobility of Li^+ ions in He gas as a function of temperature for comparison with experiment. It is concluded that the theoretical interaction energy is not inconsistent with the experimental mobility data, within the uncertainty caused by the second-order exchange energy.

539.18

5105. CORRELATION ENERGIES OF SOME He- AND Ne-LIKE SYSTEMS. A.Fröman.
Phys. Rev., Vol. 112, No. 3, 870-2 (Nov. 1, 1958).

A calculation of correlation energies of some He-like and Ne-like ions is presented. In the calculation the experimental values and the relativistic corrections to the total energies are used. The Hartree–Fock energy for Al^{+3} is calculated using analytic wave-functions. A short discussion of the relativistic corrections and of a semi-empirical formula for the correlation energies in atoms and ions is given.

539.18

5106. SCATTERING OF CHARGED PARTICLES BY NEUTRAL ATOMS. M.H.Mittleman and K.M.Watson.
Phys. Rev., Vol. 113, No. 1, 198-211 (Jan. 1, 1959).

A new technique is described for calculation of the scattering of charged particles by atoms. This is done by means of an expansion in "incoherent fluctuations" of the state of the atom. Two limiting cases are discussed — the adiabatic and the high energy limits. The structure and convergence of the expansion are investigated. Several variational techniques may be used within the framework of the method described. Finally, a detailed study is made of scattering by hydrogen atoms.

539.18 : 539.2

INFLUENCE OF MASS RATIO ON DISPLACEMENT CASCADES IN DIATOMIC SOLIDS. See Abstr. 4023

539.18

5107. THE MOLECULAR BEAM METHOD AND ITS APPLICATION TO THE MEASUREMENT OF THE DEGREE OF POLARIZATION OF SODIUM RESONANCE FLUORESCENCE.
W.Ermisch and R.Seiwert.
Exper. Tech. der Phys., Vol. 4, No. 3, 97-110 (1956). In German.

The apparatus for measurement of the degree of polarization of Na resonance fluorescence is described. Expressions are derived for the intensity of atomic beams and the energy distribution of atoms in the beam.

J.Franks

MOLECULES

539.19 : 538.69 : 538.27

PARAMAGNETIC RESONANCE OF BIS-CYCLOPENTADIENYL VANADIUM. See Abstr. 4818

539.19

5108. THE METHOD OF ATOM ASSOCIATION. H.Preuss.
Z. Naturforsch., Vol. 13a, No. 5, 364-85 (May, 1958). In German.

An improved and extended method of treating atoms in molecules is developed from the semi-empirical treatment of Moffitt and of Bingel. Examples of the application of the theory are given.

R.C.Seymour

539.19

5109. INTERNAL BARRIER IN ETHANE. D.R.Lide,Jr.
J. chem. Phys., Vol. 29, No. 6, 1426-7 (Dec., 1958).

This is calculated from the torsional frequencies for deuterated ethanes assigned by Van Riet (1957), and is found to be 3030 ± 300 cal/mole, which agrees with the thermodynamic value 2875 ± 125, but is not more accurate despite the potential superiority of the spectroscopic method.

J.Hawgood

539.19

5110. MOLECULAR EMISSION AND ATOM RECOMBINATION IN NITROGEN. J.Akriche, L.Herman and H.Grenat.
J. Phys. Radium, Vol. 19, No. 7, 649-57 (July, 1958). In French.

The distribution is calculated of the population of the different vibrational levels of an excited diatomic molecule formed by the collision of two atoms. For the temperature of 3000°K a maximum is obtained for $v' = 4$ or 5; at 300°K the maximum is for the levels $v' = 9$ or 10. These calculations are compared with the experimental results obtained from the afterglow of the first positive system of nitrogen emitted in the presence of helium. The proposed explanation of these observations involves the metastable state of atomic helium and the molecular ion of nitrogen.

539.1

5111. VIBRATION-ROTATION ENERGY OF POLYATOMIC MOLECULES. TABLES OF SECOND-ORDER TRANSFORMED HAMILTONIAN COEFFICIENTS.
M.L.Grenier-Besson, G.Amat and S.Maes.
J. Phys. Radium, Vol. 19, No. 10, 781-9 (Oct., 1958). In French.

Describes the principle of the second order computation of the rotation-vibration energy of a polyatomic molecule. Tables are given for h'_2, h''_2, h'''_2.

539.1

5112. ROTATION ENERGY OF LINEAR MOLECULES — FOURTH-ORDER CORRECTIONS. I. J.Ramadier and G.Amat.
J. Phys. Radium, Vol. 19, No. 12, 915-19 (Dec., 1958). In French.

The 4th-order rotation energy is computed, using the twice transformed Hamiltonian $h^{\dagger}_4$. A formula is given for the coefficient H_e of the term $hcH_e\,[J(J+1) - l^2]^3$.

539.19 : 535.34

THEORY OF THE INFRARED INTENSITIES OF THE FUNDAMENTAL VIBRATION-ROTATION BANDS. See Abstr. 4451

539.1

5113. THE ADHERENCE CAPTURE OF SLOW ELECTRONS TO THE MOLECULES OF SF_6 AND CCl_4. N.S.Buchel'nikova.
Zh. eksper. teor. Fiz., Vol. 34, No. 2, 519-21 (1958). In Russian.
English summary: PB 141052T-1, obtainable from Office of Technical Services, U.S. Dept. of Commerce, Washington, D.C., U.S.A.

The energy and cross-section for the resonant capture of slow electrons by SF_6 and CCl_4 molecules were measured using an apparatus of the type described by Lozier (Abstr. 4244/1934). In SF_6 the capture takes place at an energy of 0 ± 0.01 eV and in CCl_4 at an energy of 0.02 ± 0.01 eV. In both cases the resonances are found to be narrow. Assuming that the capture in both cases takes place in the energy range up to 0.05 eV the cross-section for SF_6 was found to be $(1.2 \pm 0.4) \times 10^{-15}$ cm² and for CCl_4 $(1.7 \pm 0.4) \times 10^{-16}$ cm².

A.E.I. Research Laboratory

539.19

5114. ROTATIONAL ANALYSIS OF THE β BANDS OF PHOSPHORUS MONOXIDE. N.L.Singh.
Canad. J. Phys., Vol. 37, No. 2, 136-43 (Feb., 1959).

The fine structures of three of the β bands of PO which occur near 3200 A have been analysed. The analysis shows that the upper state of this band system is a $^2\Sigma$ and not a $^2\Pi$ state, as previously believed. The rotational constants of both electronic states were determined and it is found that the ground state constants, previously determined from the γ bands, are incorrect.

539.19

5115. REMARKS ON THE PERTURBATION TERM IN FERMI RESONANCE. C.P.Courtoy.
Ann. Soc. Sci. Bruxelles I, Vol. 71, No. 3, 178-83 (Dec. 20, 1957). In French.

Suggests that for the molecules like CO_2, N_2O, the formula for the resonance energy as a function of vibrational quantum numbers given in Abstr. 8118 (1955) should be slightly modified. The modified form gives good agreement with experiment. The experimental determination of the difference between the unperturbed energy levels by means of their relation to the rotation constants (Abstr, 3482, 3484/1957) is carefully discussed.

J.Hawgood

539.19

5116. A NEW METHOD OF SEMI-THEORETICAL CALCULATION OF THE MONOCENTRIC AND DICENTRIC COULOMB INTEGRALS. A.Julg.
J. Chim. phys., Vol. 55, No. 6, 413-18 (June, 1958). In French.

It is demonstrated that atomic integrals can be calculated directly from a knowledge of the ionization potentials and the electronic affinity. Assuming that the orbitals are described by Slater's functions, it becomes possible to determine the apparent charge and, consequently, the Coulomb integrals. The re-standardization according to Löwdin (Abstr. 5998/1950) results in a slight alteration of monocentric integrals, while the dicentric integrals remain practically unchanged, and other integrals become negligible. Values thus obtained are quite close to those adopted in the empirical theory of Parr and Pariser (Abstr. 3508/1953, 5564/1955).

F.Lachman

539.19

5117. **STRUCTURAL ISOMER DISCRIMINATION BETWEEN CYANAMIDES AND CARBODIIMIDES BY NITROGEN NUCLEAR MAGNETIC RESONANCE.** J.D.Ray, L.H.Piette and D.P.Hollis.
J. chem. Phys., Vol. 29, No. 5, 1022-4 (Nov., 1958).

The structural isomers diethylcyanamide and N,N'-dicyclohexylcarbodiimide were studied by both proton and nitrogen nuclear magnetic resonance techniques. The structures $R_2N{-}C{-}N$ and $R{-}N{=}C{=}N{-}R$ have been shown to apply to cyanamides and carbodiimides, respectively.

539.19

5118. **AN INVESTIGATION OF THE MOBILITY OF THE NH_2 GROUP IN ANILINE AND VARIOUS SUBSTITUTED ANILINES BY MEASUREMENT OF DIELECTRIC LOSS.** E.Fischer and M.Ergun.
Z. Naturforsch., Vol. 12a, No. 3, 241-7 (1957). In German.

The effect of other substituents in the benzene ring on the mobility of the NH_2 group in aniline has been investigated by measurement of the effective dielectric relaxation time in solutions in carbon tetrachloride by dielectric heating at 63 Mc/s and 25°C. It is shown that the substitution of a second NH_2 group only causes restriction of the motion when they are meta to one another. One, or even two methyl groups on the ring appear to have no effect. On the other hand, motion of the NH_2 group is restricted by chlorine substitution ortho to it and even more strongly by chlorine and bromine both ortho to it. Substitution of a methyl group within the NH_2 group itself (to give N-methyl and dimethyl aniline) gives results which indicate that the group now has practically no mobility in contrast with aniline. In these molecules the results suggest that the $-NHCH_3$ and $-N(CH_3)_2$ groups may be more symmetrical with respect to the benzene ring than is the case for aniline. It is suggested that some of these systems should show multiple dielectric relaxation regions. J.G.Powles

539.19

5119. MAGNETIC MOMENTS DUE TO ROTATION IN Li^6F AND Li^7F. A.M.Russell.
Phys. Rev., Vol. 111, No. 6, 1558-67 (Sept. 15, 1958).

A molecular beam electric resonance spectrometer was used to measure the Zeeman splitting of the hyperfine structure of Li^6F and Li^7F in the $J = 1$ rotational state. From these measurements the magnitudes of the rotational magnetic moments of these molecules were determined: $(\mu_J/J)_{Li^6F} = (0.0818_{-0.0003}^{+0.0005})$ nuclear magnetons per J; $(\mu_J/J)_{Li^7F} = (0.0641_{-0.0002}^{+0.0004})$ nuclear magnetons per J. Since the signs of the rotational magnetic moments could not be measured, the sign of the electric dipole moment was not determined experimentally. A complete expression for the rotational magnetic moment in a diatomic molecule is derived. When the rotational perturbation of the electron motion is neglected the complete expression is shown to reduce to an equation for the magnetic moment of two singly charged ions. This ion-pair approximation, applied to the molecule above, indicates that the values for the moments should be positive. The nonslip electronic contribution, neglected in the ion-pair approximation, is described in terms of a semiclassical model. Numerical evaluation of the nonslip electronic contribution to the rotational magnetic moment of Li^6F and the nuclear J-dependent magnetic field of the fluorine spin-rotation interaction yields results within 10% of experimental values. The model shows that these two molecular constants, though the results of the same perturbation, arise from different parts of the charge distribution.

539.19

5120. THE ENTROPY OF A FLEXIBLE MACROMOLECULE. H.C.Longuet-Higgins.
Disc. Faraday Soc., No. 25, 86-91 (1958).

An approximate calculation is made of the configurational entropy of a flexible macromolecule. The value of the entropy per link is found to be of the same order of magnitude as the rotational entropy of a small rigid molecule. This result is used to investigate the association between a flexible molecule and a rigid lattice. It is found that dissociation occurs sharply at a certain critical temperature, and that the kinetics of this process yield an apparent activation energy proportional to the number of external bonds which are broken in detaching the molecule from the lattice.

539.19

5121. **MEASUREMENT OF THE HYPERFINE STRUCTURE OF THALLIUM FLUORIDE BY THE MOLECULAR BEAM RESONANCE METHOD.** G.Gräff, W.Paul and C.Schlier.
Z. Phys., Vol. 153, No. 1, 38-63 (1958). In German.

The magnetic moment of thallium fluoride has been measured to be $|\mu_J| = (27 \pm 11)$ micro Bohr magnetons, and the electrical dipole moment as $|\mu_{el}| = (4.2282 \pm 0.0008)$ deb for $Tl^{205}F^{19}$. The ratio of the dipole moments of the molecules with the two isotopes Tl^{205} and Tl^{203} is

$$(\mu_{el})_{Tl^{205}F^{19}} : (\mu_{el})_{Tl^{203}F^{19}} = 1.000008 \pm 0.000012.$$

The reason for the inaccuracy in the value of the magnetic moment is that the magnetic field has not been measured at the place of the umklapp process. R.Schnurmann

539.2 : 537.311.31

THE ELECTRICAL CONDUCTIVITY OF POLYCRYSTALLINE ZINC AND EFFECT OF DISLOCATIONS DUE TO ELONGATION. See Abstr. 4562

539.19 : 533.7

5122. CALCULATION OF THE ENERGIES OF GASEOUS ALKALI HALIDE DIMER MOLECULES. T.A.Milne and D.Cubicciotti.
J. chem. Phys., Vol. 29, No. 4, 846-51 (Oct., 1958).

The energies of formation of gaseous alkali halide dimer molecules from the monomers were calculated with a model suggested by Pauling. The dimers were found to be from 40 to 60 kcal more stable, energetically, than their separated monomers. These results are in agreement with the experimental data available. The free energies of dimerization were estimated and used to predict the trends observed in the ratio of monomer to dimer for several salts. It was found that the energies of dimers with different cations were slightly more negative than the average of the two pure dimers. Some experimental results supporting this conclusion are presented.

539.19

5123. AN EXPERIMENT ON THE INTERACTION OF DISSIMILAR MOLECULES. A.Michels.
Nuovo Cimento Suppl., Vol. 9, No. 1, 358-64 (1958).

The equilibrium concentrations of NH_3 were measured in the gas and liquid phase as functions of temperature and pressure up to 800 atm, in the systems $NH_3{-}N_2{-}H_2$ and $NH_3{-}A$. In both cases the partial vapour pressure of NH_3 at high pressures was much higher than that calculated by Raoult's law, and even exceeded its critical pressure with liquid still present. The increase in NH_3 density in the gas phase appears to be proportional to the concentration of A dissolved in the liquid. J.Hawgood

SOLID-STATE PHYSICS

539.2

5124. **ON THE ELECTROSTATIC THEORY OF IONIC CRYSTALS.** A.V.Stepanov.
Zh. eksper. teor. Fiz., Vol. 34, No. 6, 1661-2 (1958). In Russian.

A contribution is made towards the classification of crystals as molecular or ionic. In particular, a coefficient of "molecularity", β, is defined. The ratio of U^B, the intramolecular energy (which is approximately equal to D, the energy of dissociation of a diatomic molecule into ions), to U^M, which is the intermolecular energy referred to one bond, is calculated and denoted by β. For the substances quoted, U^M is assumed equal to $2S/l$, where S is the heat of sublimation and l is the coordination number. β is found to be 300 (CH_4); 200 (HCl); 22 ($HgCl_2$) and 10 (NaCl). A.L.Mackay

539.2

5125. **THE EQUATION OF STATE OF CRYSTALLINE MgO.** V.P.Trubitsȳn.
Zh. eksper. teor. Fiz., Vol. 34, No. 1, 221-2 (1958). In Russian.

In the region from 0 to 10^6 atmospheres the formula

$$E(v) = 93.7 \exp(-1.69\ v^{1/3}) - 3.495\ v^{-1/3} + 0.582$$

atom units/atom, calculated by a statistical method, represents the dependence of the crystal energy E at zero temperature on volume v. Above 10^6 atmospheres, deviation from the experimental values becomes serious. A.L.Mackay

539.2

5126. COHESIVE ENERGY AND WAVE FUNCTIONS FOR RUBIDIUM. J.Callaway and D.F.Morgan, Jr.
Phys. Rev., Vol. 112, No. 2, 334-6 (Oct. 15, 1958).

The cellular method was used to calculate the cohesive energy of rubidium. The potential was obtained from a self-consistent field for Rb^+ supplemented by an exchange potential. Wave-functions were obtained to order k^2 in the solid and for the lowest valence electron state in the free atom. A value of 20.7 kcal/mole was obtained for the cohesive energy, including κ terms in the Fermi energy, but neglecting any polarization effects. The ratio of $|\psi^2(0)|$ for an electron on the Fermi surface in the metal to that for an electron in the free atom was computed and found to be in good agreement with results of the Knight shift measurements.

539.2

5127. THEORY OF THE ISING MODEL FOR AN IMPERFECT LATTICE. J.Seiden.

C.R. Acad. Sci. (Paris), Vol. 248, No. 3, 389-92 (Jan. 19, 1959). In French.

539.2 : 535.375.5

5128. STUDY OF THE SCATTERING SPECTRA OF ANGLESITE. M.Scrocco and J.P.Mathieu.

Ann. Phys. (Paris), Ser. 13, Vol. 3, No. 7-8, 463-7 (July-Aug., 1958). In French.

The internal vibration spectra of anglesite ($PbSO_4$) has been examined including the measurement of relative intensities and depolarization factors. The observed frequencies have been assigned to ionic and crystal vibrations and the results are compared with previous work on crystals of $BaSO_4$ and $SrSO_4$ (See L.Couture, Abstr. 1836/1947). J.Iball

539.2

5129. LOCALIZED VIBRATIONS IN THREE-DIMENSIONAL LATTICES WITH DEFECTS. O.Litzman.

Czech. J. Phys., Vol. 8, No. 5, 521-9 (1958).

539.2

5130. SUM RULE FOR LATTICE VIBRATIONS IN IONIC CRYSTALS. R.Brout.

Phys. Rev., Vol. 113, No. 1, 43-4 (Jan. 1, 1959).

It is shown that in lattices of tetrahedral symmetry with two ions to a unit cell, in the approximation of nearest neighbour repulsive interactions, for a given wave vector q,

$$\sum_{i=1}^{6} \omega_i^2(q) = \frac{1}{\beta}\frac{18}{\bar{M}}r_0,$$

where $\omega_i(q)$ = angular frequency of the i-th mode for a given wave vector q, $\bar{M} = m_+m_-/(m_+ + m_-)$, m_+ = mass of positive ion, m_- = mass of negative ion, r_0 = interionic distance, and β is the coefficient of compressibility. This theorem serves as a useful check on numerical work as well as a relation for the downward curvature of the optical modes at small q in terms of the speed of sound. In the limit of small q, this relation becomes the first Szigeti relation. A similar theorem is true for low-density electron gases where the electrons localize on a lattice. Here one can show that

$$\sum_{i=1}^{3} \omega_i^2(q) = \omega_{pl}^2,$$

where $\omega_{pl}^2 = 4\pi ne^2/m$, which is the classical plasma frequency. (This last relation was first derived by Kohn).

539.2

5131. LATTICE VIBRATIONS IN GERMANIUM BY SCATTERING OF COLD NEUTRONS. A.Ghose, H.Palevsky, D.J.Hughes, I.Pelah and C.M.Eisenhauer.

Phys. Rev., Vol. 113, No. 1, 49-52 (Jan. 1, 1959).

The dispersion relations for the optical and acoustical vibrations in the [100] and [110] directions in germanium were determined by means of cold-neutron scattering measurements. An improved experimental method provided data with smaller experimental error. The theoretical interpretation of the results indicates a long-range force between germanium atoms.

539.2

5132. VIBRATION SPECTRA AND SPECIFIC HEATS OF DIAMOND-TYPE LATTICES. J.C.Phillips.

Phys. Rev., Vol. 113, No. 1, 147-55 (Jan. 1, 1959).

A method is described for calculating the frequency distribution of a crystal from measured dispersion curves without constructing a force constant model. The method is then used to compute a vibration spectrum for Ge based on elastic constants and the dispersion curves measured by slow neutron scattering. The vibration spectrum is used to calculate the lattice specific heat, the results agreeing with experiment to within a few per cent. A slightly modified distribution yields results agreeing to within 1%. The results are sufficiently detailed to show the necessity for including corrections due to anharmonicity even at T ~ $\theta/2$. By analogy with the results for Ge, vibration spectra are constructed for silicon and grey tin that also give good agreement with the specific heat measurements; from the spectra and also by analogy with Ge the dispersion curves for Si and grey tin can be sketched. A similar discussion is also given for InSb and diamond. Some general remarks are made concerning th relationship between specific heat curves and vibration spectra.

539.2 : 534.

THEORY OF ULTRASONIC ABSORPTION IN METALS: THE COLLISION-DRAG EFFECT. See Abstr. 4393

539.2 : 537.31

5133. THE EFFECT OF LONG AND SHORT RANGE ORDER ON RESIDUAL RESISTIVITY. A.Corciovei.

Nuovo Cimento, Vol. 11, No. 1, 118-20 (Jan. 1, 1959).

A new formalism is introduced, which does not make use of a potential of the Nordheim type. The resistivity is calculated in the usual way by perturbation methods. Besides the thermal resistivi and the residual resistivity, there appear also mixed terms. An attempt is made to evaluate them. L.Pincher

539.2 : 539.

5134. INTERFEROMETRIC MEASUREMENT OF THE INNER POTENTIAL OF GRAPHITE.

M.Durand, J.Faget, J.Feure and C.Fert.

C.R. Acad. Sci. (Paris), Vol. 247, No. 5, 590-3 (Aug. 4, 1958). In French.

The inner potential of a substance can be measured by noting the shift of the fringes in an electron interferometer as the substance is inserted in the beam. It is also necessary to know the thickness of the specimen. The inner potential of a non-crystalline film of graphite has been measured in this way and found to be 11 ± 3 volts. A.E.I. Research Laborato

539.

5135. FOURIER COEFFICIENTS OF CRYSTAL POTENTIALS. J.Callaway and M.L.Glasser.

Phys. Rev., Vol. 112, No. 1, 73-7 (Oct. 1, 1958).

A method is developed for the calculation of the Fourier coefficients of the electrostatic potential of a given distribution of valence electrons in a solid. The valence electron wave-functions are expressed as combinations of orthogonalized plane waves. The treatment takes full account of the nonspherical character of the atomic polyhedron. Application is made to lithium.

539.2

5136. THE PHONON INTERACTION OF ELECTRONS IN POLAR CRYSTALS. A.V.Tulub.

Zh. eksper. teor. Fiz., Vol. 34, No. 6, 1641-3 (1958). In Russian.

The interaction energy of electrons in a polar crystal consists of two parts, the Coulomb interaction on account of the polarization of the electronic cloud and the interaction through the phonon field. The potential of the phonon interaction of the electrons is calculated. The potential departs from the Coulomb law at a distance which for Cu_2O is 10-15 A. Consequently the fundamental energy level and to some extent the succeeding energy levels are lowered. A.L.Macka

539.2

5137. THE MEAN FREE PATH AND MOBILITY OF ELECTRONS IN IONIC CRYSTALS. L.Hrivnák.

Czech. J. Phys., Vol. 8, No. 1, 57-65 (1958).

539.2

5138. APPLICATION OF THE SELF-CONSISTENT FIELD METHOD TO THE THEORY OF SURFACE STATES OF ELECTRONS IN A CRYSTAL. J.Koutecký.

Czech. J. Phys., Vol. 8, No. 2, 148-53 (1958).

It is shown under what conditions there exist solutions to the Hartree—Fock equation, which are localized in the neighbourhood of the surface of the crystal. The results obtained earlier as to the number and character of the localized solutions of the single electron Schrödinger equation of electrons in a limited crystal, can be applied to the localized solutions of the Hartree—Fock equation after accepting plausible assumptions. A linear combination, having analogical properties to the Wannier function, can be formed from the solution of the Hartree—Fock equation for an infinite crystal.

539.2 : 537.311.33

5139. THE EFFECTIVE MASS OF ELECTRONS IN THE INTRINSIC REGION OF InSb. M.Matyáš.

Czech. J. Phys., Vol. 8, No. 5, 544-7 (1958).

The effective masses m_n/m_0 are calculated on the basis of measurements of the temperature dependence of the total magnetic susceptibility and of the Hall coefficient of single-crystal and polycrystalline specimens of n- and p-type InSb. It is shown that the effective masses are constant in the range considered and their values for the various specimens are 3.43×10^{-2} to 3.53×10^{-2}.

539.2

5140. ON THE THEORY OF ELECTRONIC—VIBRATIONAL INTERACTION FOR RARE EARTH AND ACTINIDE SERIES IONS IN CRYSTALS. II. OCTAHEDRAL COMPLEXES. R.A.Satten.
J. chem. Phys., Vol. 29, No. 3, 658-64 (Sept., 1958).

For previous work, see Abstr. 9968 (1957). A method is presented for obtaining the selection rules for transitions between shielded $4f^n$ or $5f^n$ states of rare earth and actinide ions coupled to lattice modes in crystals. This extends previous work which was limited to rigid vibrational motion of complexes in crystalline fields. The method is illustrated for ions in octahedral complexes at sites of either O_h or D_{3d} symmetry. It is clear from the examples how to apply to other complexes or to include interactions beyond the complex and thereby to obtain the effect of coupling lattice modes involving particles external to the complex. The method is contrasted with that applicable in the case of strong vibration—electronic interaction, i.e. to unshielded electronic states.

539.2 : 538.27 : 538.69

DIRECT MEASUREMENT OF ELECTRON SPIN-LATTICE RELAXATION TIMES. See Abstr. 4819

539.2

5141. ELECTRONIC STRUCTURE OF TRANSITION METALS AND ALLOYS AND HEAVY METALS. J.Friedel.
J. Phys. Radium, Vol. 19, No. 6, 573-81 (June, 1958). In French.

The electronic structure of transition metals (Fe, Co, Ni, Pd, Pt, etc...) dissolved as impurities in other metals (Cu, Al, etc..) is now fairly well understood and is reviewed. It helps one to understand the problems arising for concentrated alloys and for pure transition metals, as well as for rare earth metals (Ce, etc..) and heavy metals (U, Pu, etc...).

539.2

5142. THE PROPERTIES OF PHOTOELECTRONS IN SILVER CHLORIDE AT ROOM TEMPERATURE. P.Süptitz.
Z. Phys., Vol. 153, No. 2, 174-85 (1958). In German.

The drift mobility and average lifetime of photoelectrons in AgCl crystals were determined with an impulse technique using the print-out effect. The electron lifetime (τ) depends on the preparation of the crystal; for the purest crystals $\tau = 10^{-7}$ sec, for crystals prepared from melts, exposed to air or moisture, τ varies up to 10^{-5} sec. The changes in τ are attributed to the inclusion of cation impurities and O_2 ions at dislocations. The drift mobility of photoelectrons in pure AgCl is 52 ± 4 cm^2/Vsec; it is smaller in crystals doped with $CaCl_2$.
J.Franks

539.2

5143. ELECTRON ENERGY BANDS IN SODIUM. J.Callaway.
Phys. Rev., Vol. 112, No. 2, 322-5 (Oct. 15, 1958).

The potential energy of a valence electron in sodium is represented by the function $V(r) = -2/r + Ae^{-\beta r}/r$. The second term, which is repulsive in character, represents the effect of the core electrons. Values for A and β are determined from spectroscopic data. Energy levels of predominantly s and p symmetry are determined at four points of the Brillouin zone.

539.2

5144. ELECTRON WAVE FUNCTIONS IN METALLIC CESIUM. J.Callaway.
Phys. Rev., Vol. 112, No. 4, 1061-2 (Nov. 15, 1958).

Wave-functions to order k^2 are presented. The calculation is an application of the cellular method to a potential adapted from previous work of Sternheimer.

539.2 : 530.145

5145. NEW SOLUBLE ENERGY BAND PROBLEM. F.L.Scarf.
Phys. Rev., Vol. 112, No. 4, 1137-40 (Nov. 15, 1958).

The Schrödinger equation for $V(x) = -V_0 \csc^2(\pi x/a)$ is solved. E(k) and the effective mass are examined along with the wave-functions for various values of the parameter $(V_0 a^2)$. It is found that the wave-functions have intermediate forms even when $m^* \cong m$, $m^* \cong \infty$, and that the weak- and tight-binding approximations are not valid in these regions.

539.2

5146. ELECTRON LEVELS OF A ONE DIMENSIONAL LATTICE VACANCY. W.Schultz.
Z. Naturforsch, Vol. 12a, No. 8, 666-7 (1957). In German.

A short note discussing an idealized model. G.C.Williams

539.2

5147. THE LOWEST ELECTRONIC EXCITED STATES OF THE ANTHRACENE CRYSTAL. H.C.Wolf.
Z. Naturforsch., Vol. 13a, No. 5, 414-19 (May, 1958).

The absorption and fluorescence spectra of anthracene single crystals were measured at 90°K. Differences in the results obtained by various authors are in part due to distortions in the spectrum caused by reflection interference. The corrected spectra can be explained by assuming an allowed transition with Davydov splitting of all bands. Splitting of about 220 cm^{-1} occurs in the strongest vibrational band. The fluorescence spectra, which probably mainly depend on crystal defects, cannot be directly correlated with the absorption spectra and vary with experimental conditions.
J.Franks

539.2

5148. THE FIRST ELECTRONIC EXCITED STATE OF THE PHENANTHRENE CRYSTAL. H.C.Wolf.
Z. Naturforsch., Vol. 13a, No. 5, 420-2 (May, 1958). In German.

The first ultraviolet absorption transition and the fluorescence spectrum at 90°K of phenanthrene single crystals were photographed in the crystallographic a and b directions, and compared with the spectrum of a solution. The absorption spectrum of the crystal has the structure of an allowed transition with Davydov splitting of all bands between 50 and 0 cm^{-1}. The fluorescence spectrum consists of a low intensity region following the absorption spectrum, contributed by the ordered lattice, and a higher intensity region at longer wavelengths due to lattice defects. J.Franks

539.2

5149. THE DIFFUSION OF THE EXCITATION ENERGY IN MOLECULAR CRYSTALS. M.Trlifaj.
Czech. J. Phys., Vol. 8, No. 5, 510-20 (1958).

A theory is developed based on the conception of the exciton as the excited state of the molecule of a crystal propagating through the crystal by chance transition from one molecule to another. The theoretical results are compared with the experimental data for an anthracene crystal.

539.2

5150. EXCITON BANDS OF MIXED CRYSTALS.
G.Maier and W.Waidelich.
Z. Naturforsch., Vol. 13a, No. 7, 562-4 (July, 1958). In German.

Mixed crystal layers of CuI and CuCl, and of CuI and AgI were prepared by evaporation. At 90°K a shift in the absorption bands occurs towards longer wavelengths as the Cl or Ag content is increased. An estimate of the exciton orbit was obtained from the broadening of the bands. The double band of cubic AgI is displaced to longer wavelengths relative to that of hexagonal AgI.
J.Franks

539.2 : 537.226.2

5151. EFFECTIVE IONIC CHARGE IN ALKALI HALIDES.
J.E.Hanlon and A.W.Lawson.
Phys. Rev., Vol. 113, No. 2, 472-8 (Jan. 15, 1959).

An expression is derived for the effective charge in the Born—Szigeti equation for the dielectric constant of ionic crystals with the NaCl structure. The derivation is based on a coupled oscillator model in which the lattice vibrations are coupled to the electronic motions within the ions. The deviation of the ionic charge from its nominal value is found to be proportional to the difference in electronic polarizability between the positive and negative ions. Agreement between theory and experiment is satisfactory. Secondary effects on the index of refraction and the reststrahl frequency are calculated. The model is in semiquantitative agreement with the observed dipole moments of alkali halide molecules.

539.2

5152. MOBILE AND IMMOBILE EFFECTIVE-MASS-PARTICLE COMPLEXES IN NONMETALLIC SOLIDS. M.A.Lampert.
Phys. Rev. Letters, Vol. 1, No. 12, 450-3 (Dec. 15, 1958).

Generalizations of the exciton concept are proposed, by the consideration of bound aggregates of charged particles, at least two of which are electrons and/or holes in a band. Dissociation energies and average separations for some of these complexes are given.
P.T.Landsberg

539.2 : 538.69 : 538.27

Mn^{++}—CATION VACANCY PAIRS IN ALKALI CHLORIDES. See Abstr. 4823-4

539.2 : 537.226.31

DIELECTRIC LOSSES IN FLUORSPARS. See Abstr. 4556

539.2 : 539.27

5153. REVEALING DISLOCATION SITES IN ALUMINUM BY TRANSMISSION ELECTRON MICROSCOPY. D.L.Robinson.

J. appl. Phys., Vol. 29, No. 12, 1635-9 (Dec., 1958).

The occurrence of dislocation sites along grain boundaries is shown by transmission electron microscopy. Small thin sections of aluminum for these studies were obtained by electrolytic oxidation, with subsequent dissolution of the oxide. Dislocation sites along grain fragments in cold worked aluminum were observed which, by Cottrell's formula, indicate grain orientation differences greater than 2°. This method of examination makes possible the observation and analysis of dislocations in metals where boundaries are at other than extremely low angles of crystal misorientations. Also, it was found useful for following the movement of dislocations within grains of the material and their migration to gain boundaries.

539.2 : 536.4

5154. PRODUCTION OF DISLOCATIONS IN GERMANIUM BY THERMAL SHOCK. R.S.Wagner.

J. appl. Phys., Vol. 29, No. 12, 1679-82 (Dec., 1958).

Dislocations introduced into single crystals of germanium grown by the Czochralski technique were studied. It was found that most of the dislocations do not originate during growth, but are produced after growth as a result of thermal shock. Thermal stresses resulting from nonuniform temperature gradients during growth seem to have little or no effect on the dislocation density and distribution.

539.2 : 539.434

5155. DISLOCATION MODEL OF LOW-TEMPERATURE CREEP. J.Weertman.

J. appl. Phys., Vol. 29, No. 12, 1685-9 (Dec., 1958).

A low-temperature dislocation creep model of the exhaustion type is proposed to account for the temperature independent activation energies which were found in recent experiments. Logarithmic creep can be obtained from the model if a Gaussian distribution function of Frank—Read sources is assumed. The theory is applicable under easy glide conditions but should not be used when extensive double glide occurs. The theory can be extended into the liquid helium temperature range with the aid of Glen—Mott quantum-mechanical dislocation tunnelling.

539.2

5156. THE KINETICS OF THE FORMATION AND RECOMBINATION OF FRENKEL DEFECTS IN SILVER HALIDE CRYSTALS. R.Matejec.

Z. Phys., Vol. 151, No. 5, 595-612 (1958). In German.

Assuming a first order reaction for the formation of Frenkel defects by lattice vibrations and a second order reaction for their recombination, the concentration of defects is calculated for cooling and heating at a constant rate; the case where the number of silver vacancies is greater than the number of interstitial silver ions is discussed qualitatively. The results are compared with experiments on the electrical conductivity. J.E.Caffyn

539.2 : 548.73

THE INVESTIGATION OF DISLOCATION DENSITY AND DISLOCATION ARRANGEMENT IN PLASTICALLY DEFORMED CRYSTALS BY MEANS OF LOW-ANGLE X-RAY SCATTERING. See Abstr. 4107

539.2 : 535.4 : 537.531

EFFECT OF CRYSTAL DISTORTIONS ON X-RAY KIKUCHI LINES AND BANDS. See Abstr. 4670

539.2 : 538.27

THE EFFECT OF DISLOCATIONS ON THE INITIAL PERMEABILITY OF NICKEL IN THE RECRYSTALLIZED AND IN THE PLASTICALLY DEFORMED STATE. See Abstr. 4803

539.2

5157. STRUCTURE OF THE F BAND IN POTASSIUM CHLORIDE. G.Kuwababa and A.Misu.

J. Phys. Soc. Japan, Vol. 13, No. 9, 1066-7 (Sept., 1958).

The structure of the F band observed by measuring the F centre luminescence excitation spectrum and by studies of induced dichroism in the R and M bands of KCl is investigated. It is suggested that parts of the F absorption band away from the peak are associated with the R and M bands. Effects of impurities are not, however, ruled out. G.F.J.Garlick

53

5158. THERMAL TRANSFORMATIONS OF THE F AND Z_2 CENTRES IN CRYSTALS OF ALKALI HALIDES CONTAINING DIVALENT POSITIVE IMPURITIES. P.Camagni.

Nuovo Cimento Suppl., Vol. 9, No. 2, 372-6 (1958). In Italian.

The transformation is studied by measuring, at liquid air temperature, the height of the F and Z_2 absorption bands in KCl containing 10^{-4} moles of Sr^{2+} and coloured by heating in Na vapour. Between 80 and 110°C the amount of F absorption (~ 2.3 eV) falls that of Z_2 (~ 2.0 eV) rises, reaching equilibrium after some hours At 158°C the process is reversed. In a sample initially containing F and Z_1 centres, heating to 96°C causes rapid change of Z_1 to Z_2, followed by a decrease of the latter and increase of F to the appropriate equilibrium. The heat of activation of the reaction $F \rightleftharpoons Z_2$ i calculated to be 0.32 eV/centre. S.T.Henders

539

5159. APPROXIMATE WAVE FUNCTIONS FOR THE U CENTE BY THE POINT-ION-LATTICE METHOD. B.S.Gourary.

Phys. Rev., Vol. 112, No. 2, 337-40 (Oct. 15, 1958).

Wave-functions for the ground state and the first excited state of the U centre are calculated in the point-ion-lattice approximatio and the term values are obtained. The transition energy and the oscillator strengths are computed, and the former are compared with experimental data. They are approximately 20% smaller than the observed transition energies. A qualitative argument is presented, suggesting that this discrepancy can be removed by inclusion of the exchange energy.

539.

5160. INVERSION SYMMETRY OF M AND R CENTERS. A.W.Overhauser and H.Rüchardt.

Phys. Rev., Vol. 112, No. 3, 722-4 (Nov. 1, 1958).

The energy states of colour centres lacking inversion symmet will generally possess permanent dipole moments. Consequently the optical absorption bands of such centres will exhibit linear Stark effects and should become dichroic in large electric fields. No dichroism for the M or R bands in NaCl or KCl was observed at 78°K as a result of applied fields of 3×10^5 V/cm. Since the sensitivity of the measurement was several hundred times greater than that required to detect the field-induced dichroism calculated for a model lacking inversion symmetry, it is tentatively concluded that M and R centres possess inversion symmetry.

539.

5161. INVERSION SYMMETRY OF THE M CENTER. R.S.Knox.

Phys. Rev. Letters, Vol. 2, No. 3, 87-8 (Feb. 1, 1959).

It is shown that the M centre, consisting of two negative ion vacancies, a positive ion vacancy and an electron can have higher symmetry properties than previously assumed by inclusion of inversion symmetry. The positive ion vacancy can cross the saddle between the negative ion vacancies and this will be made easier by th presence of the electron. The net effect will be to alter the centre symmetry from $C_{2\nu}$ to D_{2h}. This would then agree with the conclus of Overhauser and Rüchhardt (see preceding abstract).

G.F.J.Garlic

539.2

5162. FIELD EMISSION FROM EXCITED COLOUR CENTRES. F.Lüty.

Z. Phys., Vol. 153, No. 2, 247-56 (1958). In German.

In an optically excited F-centre at low temperatures, the F-electron is in a bound excited state, and generally returns to the ground state with emission of radiation. Application of high electric fields enables the excited electron to enter the conduction band (Zener effect). This process was observed in measurements of fluorescence quenching and absorption. J.Franks

539.21

5163. IRRADIATION DAMAGE. Edited by J.Thewlis.

Atomic Energy Res. Establ. (Harwell) Rep M & C/R2751, 25 pp. (1958).

Papers presented at the first colloquium of the U.K.A.E.A. Diffraction Analysis Conference held at A.W.R.E. on the 2nd April, 1958.

539.21 : 541.15 : 537.56

5164. PROCEEDINGS OF THE INTERNATIONAL CONGRESS OF RADIATION RESEARCH. Edited by D.E.Smith.

Radiation Research Suppl. No. I, 582 pp. (1959).

This volume is made up of the invited papers of several sympos of the International Congress of Radiation Research held in Burlingt Vermont, on August 11-15, 1958. Abstracts of some of the papers will be published later.

539.21

5165. CHANGES IN DENSITY AND ELASTICITY MODULUS OF BOROSILICATE GLASS DUE TO IRRADIATION WITH THERMAL NEUTRONS. J.Paymal, M.Bonnaud and P.Le Clerc.
C.R. Acad. Sci. (Paris), Vol. 247, No. 25, 2335-7(Dec. 22, 1958).
In French.

Increases of about 2% in density and 4% in elasticity modulus were found in irradiated Pyrex glass. Post irradiation annealing experiments show recovery. J.Adam

539.21

5166. EFFECT OF PROTON IRRADIATION UPON HYDROGEN REDUCTION OF NiO. M.T.Simnad, R.Smoluchowski and A.Spilners.
J. appl. Phys., Vol. 29, No. 12, 1630-2 (Dec., 1958).

It is shown that the reduction of a metal oxide such as nickel oxide by hydrogen gas is strongly influenced by nuclear irradiation. The initial induction period is shortened and the subsequent reduction accelerated. The effects anneal out at higher temperatures. A probable mechanism of this acceleration is suggested.

539.21

5167. RADIATION ENHANCED DIFFUSION IN SOLIDS.
G.J.Dienes and A.C.Damask.
J. appl. Phys., Vol. 29, No. 12, 1713-21 (Dec., 1958).

A simple theory of radiation enhanced diffusion was worked out which describes the dependence of this enhancement on flux and temperature under steady-state conditions. The theoretical study also shows that the measurement of enhanced diffusion as a function of temperature can indicate the mechanism by which defects are removed from the lattice. Alpha-brass was chosen for the experimental work because it is a kinetically simple system, not complicated by nucleation, in which diffusion is easily followed by measuring the electrical resistivity changes associated with changes in short-range order. The enhanced diffusion rate during irradiation in the Brookhaven reactor has been measured in this alloy at several temperatures in the range 0 to 190°C. This enhancement is independent of temperature from 0 to 150°C, in excellent agreement with the theoretical predictions for the case where the radiation induced defects finally disappear at internal surfaces. Some implications of radiation enhanced diffusion and suggestions for further study are also discussed.

539.21

5168. THEORETICAL CONSIDERATIONS ON RADIATION-INDUCED REACTIONS OF SATURATED LONG-CHAIN HYDROCARBONS. M.Inokuti and T.Watanabe.
J. Phys. Soc. Japan, Vol. 13, No. 2, 221 (Feb., 1958).

A semi-empirical method of deducing the activation energy of the reaction between a hydrogen atom and an end-chain methyl group is briefly discussed. G.I.W.Llewelyn

539.21

5169. SMALL-ANGLE SCATTERING OF X-RAYS BY DEUTERON-IRRADIATED GERMANIUM CRYSTAL. F.E.Fujita and U.Gonser.
J. Phys. Soc. Japan, Vol. 13, No. 9, 1068-9 (Sept., 1958).

Measurements on single crystals of Ge irradiated at -180°C by 8 MeV deuterons, made in order to look for the presence of thermal spikes, indicated that the spiked regions, if they exist, are about 35 A in radius. The number of particles (which are supposed to be the spiked regions) was estimated at 2×10^{17} per cm^3. The results are in good agreement with theory. J.Thewlis

539.21 : 537.311.33

5170. LENGTH AND RESISTIVITY CHANGES IN GERMANIUM UPON LOW-TEMPERATURE DEUTERON IRRADIATION AND ANNEALING. F.L.Vook and R.W.Balluffi.
Phys. Rev., Vol. 113, No. 1, 62-9 (Jan. 1, 1959).

Simultaneous measurements of the length change and resistivity of high-purity germanium single crystals were made upon irradiation and annealing. The specimens were initially irradiated at 25°K with deuterons of average energy 10.2 MeV to an integrated flux of 6.2×10^{16} deuterons/cm^2 and annealed to room temperature. The specimens were then irradiated at 85°K to an additional flux of 9.2×10^{16} deuterons/cm^2 and annealed to 364°K. The specific length expansion for both bombardments was $\Delta L/L = (1.5 \pm 0.3) \times 10^{-21}/$(deuteron/$cm^2$). The annealing after both irradiations showed a gradual recovery of the expansion which was observable only after warming to above 200°K. The precise determination of the onset of annealing was limited by the accuracy of the expansion measurements (~ 20%). Recovery was ~ 50% complete by 300°K and ~ 85% complete by 360°K. The resistivity measurements agreed generally with previous results. A large increase in resistivity occurred during the low-temperature bombardments. The specimens became p-type after bombardment and annealing. On the first warmup after the bombardment at 25°K the resistivity decreased irreversibly by a factor of 10^6 between 65 and 300°K with a large part of the decrease coming apparently between 150 and 225°K. On the warmup from the second bombardment at 85°K an irreversible resistivity increase occurred on warming to 140°K. The resistivity then decreased irreversibly by a factor of 10^3 between 150 and 200°K. Extensive resistivity annealing, therefore, occurred in an earlier stage of the recovery process than did the experimentally observable length change annealing.

539.21 : 537.311.33

5171. LATTICE PARAMETER CHANGES IN DEUTERON-IRRADIATED GERMANIUM. R.O.Simmons.
Phys. Rev., Vol. 113, No. 1, 70-1 (Jan. 1, 1959).

A lattice expansion of 3×10^{-5} was measured in germanium irradiated by 1.5×10^{17} 9 MeV deuterons/cm^2 at low temperature and annealed to 320°K. Thus residual specimen length expansion (as measured by Vook and Balluffi in similar samples, see preceding abstract) and lattice parameter expansion are small and nearly equal after annealing to room temperature. Thermal recovery to 380°K occurred parallel to that of macroscopic length changes, but near 380°K the (211) interplanar spacing had contracted about 3×10^{-5} relative to unirradiated crystal. The lattice parameter returned to that of unirradiated crystal at 430°K. No appreciable diffraction line broadening was observed. These results provide confirmatory evidence that structural damage in deuteron-irradiated germanium consists of well-localized centres of dilatation.

539.21 : 537.311.33

5172. STRUCTURE OF DEUTERON-IRRADIATED GERMANIUM.
F.L.Vook and R.W.Balluffi.
Phys. Rev., Vol. 113, No. 1, 72-8 (Jan. 1, 1959).

The structure of deuteron-irradiated germanium is discussed in the light of the following recent experiments: (1) simultaneous measurements of the change in length and resistivity upon low temperature bombardment and annealing, (2) measurement of lattice parameter changes after annealing near room temperature (see two preceding abstracts), and (3) low-angle X-ray scattering measurements at liquid nitrogen temperature and above. A model of the damage at liquid nitrogen temperature, consisting of separated clusters of vacancies and interstitials, is proposed. The model yields a comparatively small length increase and fairly strong low-angle X-ray scattering in agreement with experiment. The model also appears capable of explaining the experimental observation that resistivity annealing occurs in an earlier stage of the recovery process than appreciable length-change annealing. The clusters must be formed, at or below liquid nitrogen temperature, either by diffusive motion of the defects or by displacement processes directly upon bombardment. If the latter mechanism holds, present theory greatly underestimates displacement distances in germanium. Additional critical experiments are proposed.

539.21

5173. STORED ENERGY RELEASE IN COPPER FOLLOWING ELECTRON IRRADIATION BELOW 20°K.
C.J.Meechan and A.Sosin.
Phys. Rev., Vol. 113, No. 2, 422-30 (Jan. 15, 1959).

The stored energy release in copper was measured in the temperature range 20°-60°K following irradiation with 1.2 MeV electrons. A differential temperature measurement was made between an irradiated specimen and an unirradiated standard. The specimens were immersed in liquid helium during irradiation; subsequent heating of the specimen was carried out in vacuum. A value of the total energy release of 2.5×10^{-2} cal/g was observed for an integrated flux of 9×10^{17} electrons/cm^2. The stored energy-resistivity ratio obtained is (5.4 ± 0.8) cal/g per micro-ohm-cm. The energy associated with a Frenkel pair is calculated to be (5.4 ± 0.8) eV for a value of 3.6 micro-ohm-cm per atomic percent Frenkel defects.

539.21 : 621.315.616.96

5174. EFFECTS OF IRRADIATION ON THE DIELECTRIC PROPERTIES OF POLYTHENE. E.Rushton.
Rep. Brit. Elect. Res. Assoc., Rep. L/T377, 7 pp. (1958).

Samples of ordinary polythene, prepared at relatively high temperatures and pressures and the new high-density polythenes, prepared at relatively low temperatures and pressures, have been examined. Irradiation dosages up to about 10 megarads have little effect on the dielectric properties of ordinary polythene but dosages of greater amount cause increases in loss tangent, and the larger the dosage the greater the increase in loss tangent. The effect of irradiation on the dielectric properties is very similar to that produced by milling at high temperature (140° C) in air and this, together with the finding that polythene containing anti-oxidant is much less affected by irradiation than polythene with no anti-oxidant, suggests that the observed effects on polythene without anti-oxidant are probably to be explained by oxidation. Very thin films of material show no greater effects on irradiation than relatively thick samples, so that the observed effect of irradiation is not predominantly a surface effect.

539.21

5175. THE EXCITATION BY SLOW NEUTRONS OF OPTICAL OSCILLATIONS IN A CRYSTAL. V.F.Turchin.

Zh. eksper. teor. Fiz., Vol. 34, No. 1, 219-20 (1958). In Russian.

The differential scattering cross-section of one molecule of NaCl (in a crystal) for the excitation of optical oscillations by slow neutrons has been calculated to be (in millibarns per steradian), for $p = 1, 2, 3, 4, 5, 6$, $d\sigma/d\Omega = 7.1, 25, 44.6, 59, 62.5$ and 54.5 respectively. p is a whole number multiplying the length of the body diagonal of the cubic unit cell. A.L.Mackay

539.21 : 537.226.2

RADIATION DAMAGE EFFECTS IN FERROELECTRIC TRIGLYCINE SULFATE. See Abstr. 4551

539.21 : 537.311.33

RADIATION-INDUCED RECOMBINATION CENTRES IN GERMANIUM. See Abstr. 4579

STRUCTURE OF SOLIDS

539.211

5176. CHEMICAL AND THERMAL POLISH OF KCl CRYSTALS.

M.Sakamoto and S.Kobayashi.

J. Phys. Soc. Japan, Vol. 13, No. 10, 1231-2 (Oct., 1958).

Cleavage steps and groups of surface dislocations in single crystals were removed by polishing with water to a depth of 100 μ. Thermal polish, consisting of heating for 1 hr at 600° C, removed the glide bands. B.T.M.Willis

539.213 : 539.431

5177. STATIC FATIGUE OF GLASS. I. R.J.Charles.

J. appl. Phys., Vol. 29, No. 11, 1549-53 (Nov., 1958).

Water vapour corrosion of a simple soda-lime glass was studied in regard to its effect on static fatigue of the same glass. A mechanism of dissolution was proposed in which alkali ion self-diffusion controls the initial steps of water corrosion and leads to breakdown of the glass network. Since experiments show that an expansion of a glass network enhances corrosion rate, it is postulated that asymmetrical conditions of expansion around a surface flaw, brought about by applied stress, could lead to growth of the flaw in a preferential direction to bring about delayed failure.

539.213 : 539.431

5178. STATIC FATIGUE OF GLASS. II. R.J.Charles.

J. appl. Phys., Vol. 29, No. 11, 1554-60 (Nov., 1958).

Static fatigue of a simple soda lime glass was investigated in relation to the sensitivity of this glass to atmospheric corrosion. An analysis of the failure process was given which is based on the concept that inherent surface flaws grow by corrosive mechanisms to critical dimensions by virtue of a reaction between water vapour in the atmosphere and components of the glass. The rate of this reaction is determined by the stress conditions around local areas and the temperature, pressure and composition of the surrounding atmosphere. Since the experimental work shows a close relationship between the temperature dependence of the failure process and that of the self diffusion of sodium ion in bulk glass it is concluded that alkali content is responsible for the very low long time strengths of most inorganic glasses.

539.213.1

5179. CONCERNING RECONSTRUCTIVE TRANSFORMATION AND FORMATION OF GLASS. D.Turnbull and M.H.Cohen.

J. chem. Phys., Vol. 29, No. 5, 1049-54 (Nov., 1958).

An explanation based on kinetic considerations is developed for the failure of some pure liquids to crystallize. The important parameters are (1) α, the ratio of the molar liquid-solid surface tension to the heat of fusion ΔH_f, (2) β, the ratio of the entropy of fusion to R, (3) $\Delta G'$, the kinetic barrier to nucleation, and (4) $\Delta G''$, the kinetic barrier to the growth of the finite crystal. In the absence of foreign nucleating agents sensible crystallization will not occur if $\alpha\beta^{1/3} \sim> 0.9$ and $\Delta G' \geqslant 0$, or if $\Delta G'$ or $\Delta G'' \geqslant 30(\Delta H_f/\beta) = 30\ RT_m$. In nonreconstructive crystallization the molecules incorporated into the crystal are the same as those existing in the liquid. In this case $\Delta G'$ and $\Delta G''$ are likely to be the same and of the order of magnitude of the free energy of activ tion for fluid flow, ΔG_f. Usually, $\alpha\beta^{1/3} \sim \frac{1}{2}$ and $\Delta G_f \ll 30\ RT_m$, i nonreconstructive crystallization,and the nucleation of crystals i clean liquids is sensible at some undercooling. There are some organic liquids in which crystallization is nonreconstructive and that do not crystallize when clean. The ratio T_b/T_m of the norma boiling point to the melting point is found to be abnormally large in these cases and near two or more for those compounds that clearly form glasses. Since β and $\Delta G'/RT_m$ are both likely to increase with T_b/T_m, the difficulty of crystallization would increa with this ratio. It is probable that this correlation also holds for inorganic molecular liquids. In reconstructive crystallization the molecular entities in the crystal differ from those which predominate in the liquid and bonds between atoms must be broken in order for nucleation to occur. Thus $\Delta G'$ can be of the order of the bond energy, which often exceeds $30\ RT_m$, and, excepting in netwo liquids, much greater than ΔG_f. Bonds between atoms also must be broken for the reconstructive growth of finite crystals. Howev this process can be promoted by impurities and molecular fragme in ways not possible in homogeneous nucleation so that $\Delta G''$ as wel as ΔG_f can be much less than $\Delta G'$, The reconstructive growth of finite crystals at the expense of a different crystal phase can be enhanced similarly so that $\Delta G''$ may be much less than $\Delta G'$ in this case also.

539.215.

5180. A MEASURING TEMPLATE (MESSSCHABLONE) FOR TH STATISTICAL EVALUATION OF OPTICAL OR ELECTRON MICRO SCOPE PHOTOGRAPHS OF DISPERSED PARTICLES. D.Schulze.

Exper. Tech. der Phys., Vol. 4, No. 5, 204-14 (1956). In German.

The mathematical basis is given of the evaluation of particle size in a dispersed system. A measuring template is described against which the particles are matched. The effect of particle sha is allowed for separately. The application of the method to the stu of powders, dusts, and micro-organisms is described.

A.E.I. Research Laborato

539.2

5181. IMPURITY PENETRATION ALONG DISLOCATION LINES IN α-Al_2O_3. R.N.Tucker and P.Gibbs.

J. appl. Phys., Vol. 29, No. 9, 1375-6 (Sept., 1958).

The effect of the ambient on the conductivity of single crystal was determined. In a dry-nitrogen atmosphere the current was a smooth function of temperature, but peaks and pulses were observe when the nitrogen was saturated with water-vapour. Similar irregularities occurred in dry nitrogen after the crystals were contami ated by boiling in HCl, NaCl or $Mg(NO_3)_2$ solutions. The results ar interpreted in terms of a given dislocation structure with impuritie penetrating a short distance along the dislocations. C.Hilsu

539.217

5182. THE DIFFUSION OF BORON IN GERMANIUM. M.D.Sturg

Proc. Phys. Soc., Vol. 73, Pt 2, 320 (Feb., 1959).

In contrast to the work of Dunlap (Abstr. 8287/1954), results are given which indicate that the diffusion rates of B in Ge are similar to those for the other Group III acceptors. R.F.Pear

539.217.5

5183. DIFFUSION AND EXCHANGE OF ZINC IN CRYSTALLINE ZINC SULFIDE. E.A.Secco.

J. chem. Phys., Vol. 29, No. 2, 406-9 (Aug., 1958).

The diffusion and exchange of zinc vapour with crystals of zinc sulphide was measured from 925 to 1075°C. The measured exchange rate was observed to be controlled by the diffusion of Zn in ZnS. A critical examination of the log D versus 1/T plot reveal that three distinct diffusion processes are operative in the temperature range studied. At 1 atm. zinc pressure, the diffusion coefficients were calculated as

$$D = 3 \times 10^{-4} \exp(-35\ \text{kcal}/RT)\ \text{cm}^2\ \text{sec}^{-1} \text{ below } 940^0\text{C},$$

$$D = 1.5 \times 10^4 \exp(-75\ \text{kcal}/RT)\ \text{cm}^2\ \text{sec}^{-1} \text{ between } 940^0 \text{ and } 1030^0\text{C, and}$$

$$D = 1 \times 10^{16} \exp(-150\ \text{kcal}/RT)\ \text{cm}^2\ \text{sec}^{-1} \text{ above } 1030^0\text{C}.$$

Variation of zinc pressure from 0.25 to 2.0 atm. showed that D varies as $P_{Zn}^{1.5}$. Values of D were observed to increase with increasing penetration of Zn into the ZnS crystals. The kinetic and structural interpretations of these results are discussed.

539.23

5184. ON THE FORMATION OF CARBON FILMS IN A GLOW DISCHARGE IN A BENZENE ATMOSPHERE. A.Heisen.

Ann. Phys. (Leipzig), Folge 7, Vol. 2, No. 1-2, 23-35 (1958). In German.

The process of film formation on an object in a glow discharge was studied. It is concluded that adsorbed benzene molecules on the object are broken down by the bombarding particles and thereby transformed into a film. A.E.I. Research Laboratory

539.232 : 537.311.33

5185. PREPARATION OF TRANSPARENT SEMICONDUCTOR LAYERS ON GLASS BY THE HYDROLYSIS OF ACTIVATED $SnCl_4$. J.Wojciechowski.
Arch. Elektrotech. (Warsaw), Vol. 7, No. 3, 457-67 (1958).
In Polish.

Describes the coating method and the results obtained with layers prepared by the hydrolysis of $SnCl_4$ with some $SbCl_3$ added. The layers have a resistance of about 20 ohms (measured between opposite sides of a square) and a transparency of 85-90%. It is claimed that the layers are resistant to abrasion, as well as to atmospheric and other chemical agents. F.Lachman

539.234

5186. SURFACE AREA VARIATION OF EVAPORATED BARIUM FILM BY OXIDATION. Y.Tuzi and H. Okamoto.
J. Phys. Soc. Japan, Vol. 13, No. 2, 225 (Feb., 1958).

The surface area, S, was measured as a function of the amount of oxygen absorbed, Q. S diminished at first as Q increased, reached a minimum at a value of Q corresponding to 3-10 layers of BaO, and then increased linearly with Q. B.T.M.Willis

539.262 : 545.824 : 537.533

RESOLUTION OF ELECTRON PROBE MICROANALYSERS. See Abstr. 4701

539.27

5187. THE INVESTIGATION OF CRYSTAL POINTS WITH A FAST ELECTRON BEAM. H.Jahrreiss.
Ann. Phys. (Leipzig), Folge 7, Vol. 1, No. 1-3, 36-54 (1958).
In German.

The possibility of using a crystal point as object for electron diffraction and field emission was investigated. If the point was used for field emission immediately before it was used for electron diffraction, electric fields were present at the point; these could be removed by heating and were probably due to an absorbed double layer of hydrocarbons. The distortion of the central spot produced by bringing a crystal point at a known potential near to the electron stream was studied and a simple treatment of the effect was developed. J.E.Caffyn

539.27 : 537.533

STABILITY OF RHENIUM UNDER ION BOMBARDMENT. STRUCTURE STUDY. See Abstr. 4682

539.27 : 538.221

NEUTRON DIFFRACTION INVESTIGATIONS OF THE MAGNETIC ORDERING IN $FeBr_2$, $CoBr_2$, $FeCl_2$, AND $CoCl_2$. See Abstr. 4784

ELASTICITY . STRENGTH . RHEOLOGY

539.31

5188. SOME SPECULATIONS ON POSSIBLE INSTABILITY PHENOMENA IN THE MECHANICAL BEHAVIOUR OF PROTEINS. K.R.Makinson.
Proceedings of International Wool Textile Conference (Australia, 1955), D54-D61.

There appears to be no sound basis in elasticity theory for the common assumption that the strain-energy function must necessarily be unique, i.e. that the elastic-constant matrix must necessarily be symmetrical, under all conditions. If this requirement does not hold for a particular solid, observable effects will be produced: the directions of vibration of the three elastic waves which can be propagated freely in any direction in the solid will not be mutually perpendicular. In a special case, which is discussed, circularly polarized waves will be propagated freely, with amplitudes which are exponential functions of the distance of propagation. Two types of structure which could give rise to such phenomena are described in broad outline: the discussion of these structures indicates that such phenomena probably can occur only in solids, such as long-chain polymers and proteins, which contain very large and complex lattice units. One of the structures described is based specifically on the α-keratin helix.

539.319 : 538.245

MAGNETIC DOMAIN STRUCTURE IN Si–Fe CRYSTALS WITH INTERNAL STRAIN. See Abstr. 4797

539.32

5189. THE ELASTIC CONSTANTS OF [99.7% PURE] VANADIUM SINGLE CRYSTALS. E.Sándor and W.A.Wooster.
Acta cryst., Vol. 12, Pt 4, 332-6 (April, 1959).

Studied by using diffuse X-ray reflections. A (110) face was ground on a cleavage block and electropolished. A photograph at about 3° away from the 110 Bragg setting was taken using Cu Kα radiation with a nickel screen covering the photographic film. From a microdensitometer survey of the diffuse spot the first-order diffuse intensity for a number of directions in reciprocal space passing through the reciprocal lattice point 110 was determined. From the relative intensities the ratios c_{12}/c_{11} and c_{44}/c_{11} were determined. The accuracy of this determination was much improved by taking into account the known values of the elastic constants of polycrystalline vanadium. From the elastic ratios the absolute values of the constants were obtained using the cubic compressibility. The final values were ($\times 10^{11}$ dyn cm^{-2}): $c_{11} = 19.6 \pm 0.3$; $c_{12} = 13.5 \pm 0.2$; $c_{44} = 6.7 \pm 0.5$.

539.32

5190. DYNAMIC MECHANICAL BEHAVIOR OF IRRADIATED POLYETHYLENE. C.W.Deeley, J.A.Sauer and A.E.Woodward.
J. appl. Phys., Vol. 29, No. 10, 1415-21 (Oct., 1958).

Samples of a "high-density" polyethylene ($\rho = 0.964$ g/cc) irradiated in a nuclear reactor to thermal neutron doses as high as 2.9×10^{18} nvt and of "low-density" polyethylene ($\rho = 0.915$ g/cc) subjected to gamma-ray bombardment from a Co^{60} source up to a dosage of 1×10^9 rep have been investigated by dynamic mechanical methods from 80°K to 450°K at audiofrequencies. Degrees of cross-linking were estimated from the observed changes in resonance frequency at temperatures where the specimens were "rubber-like". Densities and X-ray crystallinities at 25°C were also measured. For the pile-irradiated "high-density" polyethylene the γ peak found around 165°K shows a marked increase in height and area at dosages above 10^{18} nvt. The α peak at about 390°K decreases markedly upon receiving a thermal neutron dose of 0.6×10^{18} nvt. Further changes in this absorption with higher dosages are obscured by the appearance of a β peak around 330°K which is almost absent in the unirradiated material; the appearance of the β region is attributed to the creation of branch points and cross-link points in the essentially linear polymer by the irradiation. The irradiated "low-density" specimens exhibit three damping peaks. Over the dosage range studied the γ peak (165°K) increases in height and area, the β peak (270°K) shifts to higher temperatures, and the α peak (360°K) shifts to lower temperatures with increasing dose. The cross-linking degree is not proportional to dose and to the highest dosages studied, there is very little, if any, reduction in X-ray crystallinity.

539.32

5191. THEORETICAL VALUES OF THE DYNAMIC STRETCH MODULI OF FIBER-FORMING POLYMERS. W.J.Lyons.
J. appl. Phys., Vol. 29, No. 10, 1429-33 (Oct., 1958).

Employing concepts first applied to textile fibres by Meyer and Lotmar [Helvetica Chimica Acta, Vol. 19, 68 (1936)] in calculating the elastic stretch modulus of the crystalline domain of cellulose, the moduli of crystalline polyhexamethylene adipamide (α form), and polyethylene terephthalate were derived. The treatment employs interatomic force constants for the stretching and bending of primary valence bonds, applied to molecular geometries deduced from the crystal structures of these polymers as determined by Bunn and co-workers. The modulus of the crystal cell of the first material (nylon 66) is calculated to be 15.7×10^{11} dyne cm^{-2}, while that of the second is 14.6×10^{11} dyne cm^{-2}. Supposedly these are approximately the modulus values which fibres having perfectly oriented, efficiently packed molecules would have. In both cases the theoretical value is at least an order of magnitude larger than that found experimentally for actual production samples.

539.32 : 534.39

5192. DYNAMIC MECHANICAL PROPERTIES OF POLYVINYL STEARATE AT AUDIO-FREQUENCIES. E.R.Fitzgerald.
J. appl. Phys., Vol. 29, No. 10, 1442-50 (Oct., 1958).

Measurements of the complex shear compliance ($J^* = J' - iJ''$) of polyvinyl stearate at frequencies from 50 to 5000 c/s have resulted in the discovery of several sharp resonances in the compliance as previously described. The effects of temperature and static stress normal to the direction of the dynamic shearing stress were studied for this material. The two principal resonances observed at 25°C were located at (1) 180 and (2) 500 c/s. At successive temperatures of 30, 36, and 42°C the first resonance remained essentially unchanged, but the second resonance shifted to higher frequencies and decreased in magnitude until it virtually disappeared at 42°C. A return to 25°C and a reapplication of a slight static stress resulted in the return of the second resonance (at 525 c/s). At successively increasing static stresses corresponding to compression up to 1.8% the second resonance now decreased in magnitude and shifted to higher frequencies. The first resonance disappeared at a static compression of 0.8%. Similar effects of static stress were observed at room temperature (~ 25°C) on a second set of samples of different dimensions. The reversibility of the effects of static compression were demonstrated by the second set of samples where, for example, a resonance originally present at 2.8% static compression disappeared at 3.7% and reappeared when the static compression was reduced to 3.1%. The reversible nature of the effects of static stress seems to preclude the possibility of an explanation of the resonances in terms of changes in dislocation density.

539.32 : 534.321.9

5193. ELASTIC CONSTANTS OF POTASSIUM IODIDE AND POTASSIUM CHLORIDE. M.H.Norwood and C.V.Briscoe.

Phys. Rev., Vol. 112, No. 1, 45-8 (Oct. 1, 1958).

The sound velocities and elastic constants were measured for pure single crystals of KI and KCl by the ultrasonic pulse technique over the temperature range from 4 to 300°K. In KI, $c_{11} = 3.38$, $c_{12} = 0.22$, and $c_{44} = 0.368$ in units of 10^{11} dynes/cm^2 at 0°K according to extrapolations from 80°K. In KCl, measurements of all three constants were made over the entire temperature range down to 4°K and their values at 0°K are $c_{11} = 4.83$, $c_{12} = 0.54$, and $c_{44} = 0.663$ in units of 10^{11} dynes/cm^2. The Debye characteristic temperature at 0°K, θ_0, was calculated from these very low-temperature values of the elastic constants to give 129° ± 2°K for KI and 234° ± 1°K for KCl. The specific heats of KI, KCl, and KBr were calculated by using a combination of a Debye and an Einstein term in the expression for the specific heat. Agreement between this simple theory and experiment becomes better as the ratio of ionic radii and masses increases in these three salts. In the four alkali halides so far studied, there is evidence that the Cauchy relation, $c_{12} = c_{44}$, is satisfied at about $T = \theta_0$. No reason is offered for this coincidence.

539.32

5194. ELASTIC CONSTANTS OF α-BRASSES: ROOM TEMPERATURE VARIATION WITH SOLUTE CONCENTRATION. J.A.Rayne.

Phys. Rev., Vol. 112, No. 2, 1125-30 (Nov. 15, 1958).

Measurements were made on a representative series of α-brasses. The variation with solute concentration of the shear constant C suggests that there is an appreciable contribution to it resulting from the onset of overlap between the Fermi surface and the {111} faces of the Brillouin zone. There is reasonable agreement between the experimentally determined magnitude of this contribution and that predicted from theory. According to the latter, there should be no corresponding contribution to the shear constant C', which prediction appears to be in accordance with experiment.

539.32

5195. ELASTIC CONSTANTS OF INDIUM ANTIMONIDE FROM 4.2°K TO 300°K. L.J.Slutsky and C.W.Garland.

Phys. Rev., Vol. 113, No. 1, 167-9 (Jan. 1, 1959).

The adiabatic elastic constants of a single crystal of InSb were measured by an ultrasonic pulse technique in which 10 Mc/s acoustic waves were employed. The elastic constants extrapolated to 0°K are, in units of 10^{12} dynes/cm^2, $c_{11} = 0.6918$, $c_{12} = 0.3788$, and $c_{44} = 0.3132$. A Debye characteristic temperature, θ, of 205° ± 2°K at 0°K was calculated from these values of the elastic constants.

539.32

5196. MECHANISM OF CARBON DIFFUSION PEAK IN F.C.C. IRON-NICKEL ALLOYS. Wu Tzu-liang and Wang Chi-min.

Scientia Sinica, Vol. 7, No. 11, 1029-53 (Nov., 1958).

An internal friction peak induced by carbon diffusion has been observed in f.c.c. iron-nickel alloys. At a vibrational frequency of 1.4 c/s, the peak occurs at about 500°K. This peak arises, under the influence of an oscillating load, from the preferential rotation of the axes of carbon pairs existing in the specimen. These carbon pairs were formed by the interaction between the substitutional carbon atoms and their neighbouring interstitial carbon atoms. Based upon this mechanism, and considering the possible redistribution of the carbon atoms amongst the frozen-in vacancies in the specimen in the course of internal friction measurement, an equation giving the quantitative relationship between the peak height and the carbon concentration has been derived. The energy of vacancy formation together with the binding energy of the carbon pairs have been determined. The characteristics of the carbon diffusion p in f.c.c. metals are: (1) the internal friction curve is not symm cal with respect to the peak position, the internal friction on the high temperature side being smaller than on the low temperatur side; (2) the $T'Q^{-1}_{max}$ product varies with the peak temperature T the lower the peak temperature, the higher will be the $T'Q^{-1}_{max}$ product; (3) the peak position drifts with the carbon concentratic as well as the quench temperature of the specimen. Either an in rease of the carbon concentration or an increase of the quench temperature tends to shift the peak position toward a lower temp ture. These characteristics are interpreted in terms of the car pair theory given in the paper.

539.371 : 536.

5197. COUPLING OF ELASTIC AND THERMAL DEFORMATIONS. I. G.Paria.

Appl. sci. Res. A, Vol. 7, No. 6, 463-75 (1958).

The general solution for the stress and temperature distribu tion in an isotropic thermoelastic solid occupying the half space is given when the classical heat conduction equation is suitably modified to take into account the effect of variation of strain on t variation of temperature, the boundary of the solid being assumed to be stress-free but with prescribed temperature distribution. As an illustration, the axial temperature distribution in a particu metal is found for small values of time.

539.

5198. MEASUREMENT OF THE ISOTHERMAL VOLUME DILATION ACCOMPANYING THE UNILATERAL EXTENSION OF RUBBER. F.G.Hewitt and R.L.Anthony.

J. appl. Phys., Vol. 29, No. 10, 1411-14 (Oct., 1958).

Using a torsion balance immersed in water and natural rubbe ring specimens cured with di-tertiarybutyl-peroxide, measureme were made of the isothermal volume dilation of rubber for mean extensions ϵ = 14, 33, and 51%, thus extending the result of Gee, Stern, and Treloar (Abstr. 3822/1951) to lower strains. Chain molecular weights M_c = 3000, 4400, 5100, and 5500 were employed The chain molecular weights were determined by swelling in benz the uncertainty in each determination being about 10%. Observed fractional volume increases ranged from 3.2×10^{-5} for $\epsilon = 14$ an $M_c = 5500$, to 14×10^{-5} for $\epsilon = 51$ and $M_c = 3000$. Using Gee's expression for the volume dilation, but obtaining the slope of the stress-strain curve from the statistical theory, curves were fitted to the data. The fitting process constituted a determination of You modulus E for each rubber specimen. The resulting curves are in good agreement with those of Gee, Stern, and Treloar. Additional determinations of E were made from rough stress-strain curves a from the swelling data, the internal agreement between the three determinations being fair.

539.37

5199. ON THE INFLUENCE OF EXTERNAL STRESS ON THE RELAXATION STRESS DURING PLASTIC DEFORMATION. M.B.Makogon, V.E.Panin, V.F.Sukhovarov, L.P.Abramets, A.D.Korotaev and N.A.Shcherbakov.

Dokl. Akad. Nauk SSSR, Vol. 122, No. 2, 219-21 (1958). In Russian.

The effect of external stress on the rate of plastic deformation temperature, nature of substance and intensity of the relaxation stress are studied for electrolytic copper and its alloys with Ni, Al and Zn. The annealing and the secondary deformation temperatures and stresses were measured at room temperatures and at 350°C. It was found that external stress generally stimulates the intensity of the relaxation stress.

J.K.Skwirzynsk

539.374 : 534.13

5200. FORCED OSCILLATIONS IN AN ELASTIC-PLASTIC SYSTEM. G.Z.Gershuni and E.M.Zhukovitskii.

Fiz. Metallov i Metallovedenie, Vol. 6, No. 2, 339-46 (1958). In Russian.

A theoretical investigation of the forced vibration of an elastic and an elastic–plastic system, with hysteresis and friction. The previous experimental work on monocrystal zinc and aluminium is reviewed, and the force displacement curve for the material is assumed to be made up of straight lines, thus giving the nonlinear characteristics. Galerkin's method is used to develop equations for the amplitude, etc. and the resonance frequencies for different systems are discussed, together with the particular case of no friction.

P.G.Morgan

539.374

5201. THE INFLUENCE OF GRAVITY ON THE FOLDING OF A LAYERED VISCOELASTIC MEDIUM UNDER COMPRESSION. M.A.Biot.

J. Franklin Inst., Vol. 267, No. 3, 211-28 (March, 1959).

The theory of folding of a layered viscoelastic medium under a horizontal compression parallel with the layer, as developed in previous publications (see, for example, Abstr. 425/1958), is extended to take into account the influence of gravity. Characteristic features of the folding are evaluated in terms of nondimensional parameters. The influence of gravity appears through a parameter which depends on the relative magnitude of the gravity forces and the horizontal compression. Specific cases discussed are that of a layer on top of a half-space and the layer embedded between two half-spaces, with the bottom medium either denser or less dense than the top one.

539.374

5202. PLASTIC DEFORMATION OF IONIC CRYSTALS.

J.F.Laurent.

J. Phys. Radium, Vol. 19, No. 6, 602-11 (June, 1958). In French.

Many authors, using different methods, have definitely proved the existence of dislocation lines in ionic crystals. The dislocation theory enables one to explain and interpret phenomenon related to the plastic deformation. The propagation of plastic slip is equivalent to a movement of dislocations in the slip plane. Theoretical calculations of dislocation energies are in complete agreement with experimental results: plastic flow always occurs on the (110) plane. The great influence of the exterior medium on plastic deformation can be explained by an interaction of dislocation lines with this medium. The variation of physical properties of stressed ionic crystals can be easily explained by the creation of vacancies during the movement of dislocations.

539.379

5203. NOTE ON THE THEORY OF DEVELOPMENT OF REAL MICRO-CRACKS IN HARD SUBSTANCES DURING DEFORMATION.

D.I.Shil'krut.

Dokl.Akad. Nauk SSSR, Vol. 122, No. 1, 69-72 (1958). In Russian.

Following Rebinger and Frenkel, the author discusses a two-dimensional representation of a micro-crack with a variable width, unlike that of Griffith, where only the length of a crack is taken into consideration. The critical length and the critical stress of a micro-crack is deduced on the basis of this new model. These allow for a qualitative explanation of various modes of action of adsorption layers and of surface-active regions, which facilitate deformation and destruction of hard substances. J.K.Skwirzynski

539.383 : 532.112

5204. EFFECT OF PRESSURE ON ANELASTIC RELAXATION IN SILVER—ZINC.

G.W.Tichelaar and D.Lazarus.

Phys. Rev., Vol. 113, No. 2, 438-44 (Jan. 15, 1959).

Using a novel experimental apparatus, studies were made of the effect of hydrostatic pressure up to 9000 kg/cm^2 on the rate of stress relaxation at constant small strain in an Ag-30 atomic percent Zn alloy, where the relaxation process is presumably diffusion limited. For temperatures between 110 and 150°C the relaxation time is found to increase exponentially with pressure. The zero-pressure data are in good agreement with previous work by Nowick. At 9000 kg/cm^2 the relaxation time is about a factor of four greater than at 1 kg/cm^2, for all temperatures. The pressure dependence can be interpreted in terms of an "activation volume" of 5.36 ± 0.07 cm^3/mole, which is about half the atomic volume of the material. This may mean that the volume of formation of a vacancy is at most about half of the molar volume, which number is in accordance with a recent calculation by Tewordt.

539.388.24

5205. SHAPE CHANGES OF INTERNAL SURFACES IN EXTRUSION.

W.B.Nowak and E.J.Rapperport.

J. appl. Phys., Vol. 29, No. 9, 1382-3 (Sept., 1958).

In certain extrusion processes, it is necessary to push several pieces of metal through the machine one behind the other and to control the final shape of the interfacial surfaces. The change of shape of these interfacial surfaces may be determined by scribing a grid on an axial plane to delineate the deformation. By charting on an extruded axial plane grid the trace of the desired final shape, the necessary initial shape can be graphically determined. Alternatively, the magnitude and direction of particle velocities on an axial plane of a cylinder are determined by examining the incremental deformation steps of the grid coordinate intersections. These vector velocities are then used to examine the changes of shape of the internal surfaces during extrusion. The technique was checked experimentally. A.C.Whiffin

539.389.3

5206. THE EFFECT OF G-P(1) AND G-P(2) AGGREGATES ON THE PLASTIC DEFORMATION OF AN AGE-HARDENABLE Al—Cu 4% ALLOY.

K.Matsuura, S.Izumi and S.Koda.

J. Phys. Soc. Japan, Vol. 13, No. 3, 318-19 (March, 1958).

When specimens of Al—Cu 4% alloy were aged at 130° C, age-hardening occurred in two stages separated by a flat plateau. The initial rise and the plateau were thought to be due to formation of G-P(1) aggregate and the second rise to G-P(2) aggregate. Polycrystalline wires and strips were solution-treated for 30 min at 530° C, air-quenched and then aged at 130° C for various periods. To eliminate the effect of the formation of G-P(1) during plastic deformation, tensile tests were made at −196° C. The yield strength increased with ageing, but the rate of strain-hardening changed little during the second rise of hardness. Slip patterns observed on air-quenched specimens showed no distinct difference for ageing periods from 12 hr to 9 days. It was concluded that the average internal stress due to formation of G-P zones is an important cause of age-hardening. A.C.Whiffin

539.389.3

5207. THE MECHANICAL RELAXATION IN PURE ICE SINGLE CRYSTALS.

P.Schiller.

Z. Phys., Vol. 153, No. 1, 1-15 (1958). In German.

The damping of mechanical oscillations at frequencies between 800 and 6000 c/s was measured over the temperature range 0° to 100° C. Both longitudinal and torsional vibrations were induced in cylindrical crystal bars, and specimens of differing crystal orientation were tested. A simple relaxation effect was found, in good agreement with the dielectric relaxation but of smaller magnitude. The frequency of maximum absorption depended only on temperature, but the magnitude of absorption varied with crystal orientation and mode of oscillation. The theoretical predictions of Bass (see following abstract) were verified. K.W.Plessner

539.389.3

5208. ON THE THEORY OF MECHANICAL RELAXATION IN ICE.

R.Bass.

Z. Phys., Vol. 153, No. 1, 16-37 (1958). In German.

The problem is treated on the basis of a statistical picture of the structure, calculating the effect of the electrostatic interaction of neighbouring hydrogen bridges on the equilibrium configuration. Each bridge is represented as a point dipole. Results are in agreement with experimental data on the dependence on crystallographic direction and on temperature of the maximum value of the logarithmic decrement of the amplitude of oscillation. The moment of the dipole is estimated as $< 0.35 \times 10^{-18}$ e.s.u., and thus the energy difference between different configurations is smaller then hitherto believed. L.Pincherle

539.389.3

5209. RELAXATION OF NONORIENTED MICROSTRESSES. II.

B.M.Rovinskiĭ and V.G.Lyuttsau.

Zh. tekh. Fiz., Vol. 27, No. 9, 2162-6 (1957). In Russian. English translation in: Soviet Physics — Technical Physics (New York), Vol. 2, No. 9, 2005-8 (Sept., 1957).

For Pt I, see Abstr. 9433 (1957). Curves were obtained for the recovery of X-ray diffraction line breadth of plastically deformed pure metals (aluminium, copper) at room temperature. The study shows that changes in the breadth of the lines with time are due basically to the relaxation of nonoriented microstresses.

539.4

5210. EXPERIMENTAL INVESTIGATIONS OF THE STRENGTH UNDER DYNAMIC LOADING OF CIRCULAR PLASTIC DISKS.

E.J.Giessmann.

Exper. Tech. der Phys., Vol. 2, No. 1, 30-7 (Jan., 1954). In German.

A bomb method has been used with the plastic disk as one of the end plates of the cylindrical combustion chamber. Measurements have been made with three charges of different combustion velocity. No correlation has been found with the results of static tests. R.Schnurmann

539.4

5211. MECHANICAL BEHAVIOR OF A POLYMER AT TEMPERATURES THROUGH THE GLASS TRANSITION TEMPERATURE.

J.R.Stevens and D.G.Ivey.

J. appl. Phys., Vol. 29, No. 10, 1390-4 (Oct., 1958).

Stress-temperature (constant strain) and length-temperature (constant stress) measurements were made on Paracril-35 (a butadiene-acrylonitrile copolymer) in the temperature range −80° C to

25°C, which includes the glass-like, transition, and rubber-like states for this material ($T_g \sim -25°C$). Time effects are observed in the transition region, but for temperature gradients used (down to about 1°C in 4 hours) the behaviour at low temperatures is unique, indicating the existence of a real transition. This behaviour is independent of the strain imposed at room temperature. The snift in transition temperature (in the length-temperature work) with extension is found to give quantitative support to the theory that the transition occurs at a certain minimum volume. In the rubber-like region, behaviour is represented by the usual equation of state.

539.4

5212. INTERNAL STRESSES AND FATIGUE IN METALS.

A.M.Freudenthal.

Phys. Today, Vol. 12, No. 2, 16-19 (Feb., 1959).

This is a report of an international symposium which was held on September 3-5, 1958 at the General Motors Research Laboratories. While most of the papers dealt with either residual stress or fatigue, others were concerned with some aspect of their interaction and emphasis is given to this in this report.

539.4.01

5213. NEW LAW FOR LONGITUDINAL STRENGTH.

I.A.Oding and V.N.Geminov.

Dokl. Akad. Nauk SSSR, Vol. 122, No. 2, 222-5 (1958). In Russian.

A new equation is proposed for the time of service of metals under longitudinal stress:

$$t^m = \frac{A_1}{\sinh[\alpha(\sigma - \kappa/\sigma)] \cdot \sinh(\beta\sigma)}$$

where t = time of service of metal, σ = stress, and A_1, α, β, m, κ are coefficients, which are determined in this paper for some steels. The equation can be sectionally simplified for different ranges of stresses where the coefficients abruptly change their local values. The new law has been widely tested and it is claimed that it shows better agreement with practical results than the usual one, deduced from the dislocation theory. J.K.Skwirzynski

539.42

5214. ELECTRODYNAMIC TENSILE APPARATUS OF HIGH RATE OF STRAIN. F.X.Eder.

Exper. Tech. der Phys., Vol. 1, No. 1, 35-9 (Aug., 1953). In German.

One end of a small tensile specimen is attached to the armature of an electromagnet, the other is attached to a lever type dynamometer which twists under load. Light is reflected from a mirror on the shaft of this dynamometer on to another mirror attached to a lever system rotated by the movement of the end of the specime attached to the magnet. Rotation of the dynamometer mirror thu indicates load and rotation of the other mirror indicates strain a the beam of light falls upon a photographic plate to give a load st diagram. The light is shone on to the first mirror through a spi ning perforated disc which superimposes a time-scale on the rec Results are quoted for tests on a 0.48 mm. dia. copper wire at 20°C and show that the tensile strength rises with rate of loading from 22 kg/mm² at a rate of strain of 1 sec^{-1} to 32 kg/mm² at 300 sec^{-1} A.C.Whi

539

5215. REMARKS ON HIGH SPEED TENSILE TESTS. P.Täube

Exper. Tech. der Phys., Vol. 1, No. 1, 39-44 (Aug., 1953). In Germa

In high speed tensile tests, it is not sufficient to use a single size of specimen and to compare the stress/strain diagrams obtained at various rates of loading. The differences between the diagrams may well be due to wave effects in the specimens. It is suggested that the dimensions of the specimens should be varied (maintaining geometrical similarity). In each test the rate of str expressed in terms of the extension must be kept identical, and th diagrams may then be compared. The technique is limited by the fact that very small test pieces lead to results which are affected by the specimen dimensions. A.C.Whif

539.

5216. A NEW METHOD OF DETERMINING THE TENSILE STRENGTH WITH HIGH DEFORMATION VELOCITY.

E.J.Giessmann.

Exper. Tech. der Phys., Vol. 1, No. 2, 79-85 (Sept., 1953).

Stress is measured piezoelectrically and strain photoelectric Three different apparatuses are described using explosive charge to produce the high deformation velocity. J.M.Hou

539.4

5217. CREEP OF SINGLE CRYSTALS OF ZINC IN EASILY FUSIBLE MELTED METALS. V.A.Labzin and V.I.Likhtman.

Dokl. Akad. Nauk SSSR, Vol. 121, No. 3, 443-5 (1958). In Russian.

Tin and lead were chosen as surface-active media, whose adsorption increases the speed of creeping of single zinc crystals. Measurements of deformation were made at room temperature and at 350°C; the speed of creeping increased 15 times in this range. It also increased with the concentration of surface-active compone (tin) in a Pb—Sn alloy. J.K.Skwirzyns

PHYSICAL CHEMISTRY

PHASE EQUILIBRIUM CHEMICAL REACTIONS

541.123.5

5218. HYDROGEN → DEUTERIUM EXCHANGE REACTION IN FIBROUS PROTEINS. I. R.D.B.Fraser and T.P.MacRae.

J. chem. Phys., Vol. 29, No. 5, 1024-8 (Nov., 1958).

See also Abstr. 892 (1959). Measurements of infrared spectra obtained with polarized radiation are reported for nylon, silk fibroin, feather rachis, stretched wool, and kangaroo tail tendon before and after reaction with deuterium oxide. In every case except tendon, replacement of hydrogen by deuterium in the peptide linkage occurs preferentially in the less well oriented regions of the specimen. A residual absorption band between 4600 and 4650 cm^{-1} is evident in the partially deuterated protein specimens and it is suggested that this may be assigned to a combination of CH and CO stretching modes.

541.127

5219. KINETIC STUDIES OF HYDROXYL RADICALS IN SHOCK WAVES. II. INDUCTION TIMES IN THE HYDROGEN—OXYGEN REACTION. G.L.Schott and J.L.Kinsey.

J. chem. Phys., Vol. 29, No. 5, 1177-82 (Nov., 1958).

For Pt I see Abstr. 900 (1959). The formation of OH in the shock wave induced combustion of H_2 and O_2 was measured by oscillographically recording the absorption of ultraviolet OH line radiation. The main features of the reaction course are: (1) an induction period whose length, t_i, varies inversely with $[O_2]$; (2) an increase in the product $[O_2]\ t_i$ as t_i becomes short compared to the vibrational relaxation time of O_2; and (3) at the end of the induction period, a sigmoid rise of [OH] to a maximum, followed by a slow decrease.

541.12

5220. KINETICS OF D ATOM REACTIONS WITH H_2, CH_4, AND D_2CO. R.Klein, J.R.McNesby, M.D.Scheer and L.J.Schoen.

J. chem. Phys., Vol. 30, No. 1, 58-60 (Jan., 1959).

The activation energies and steric factors of the abstraction reactions $D + D_2CO \rightarrow D_2 + DCO$ and $D + CH_4 \rightarrow HD + CH_3$ were determined by the technique of competing reactions. Mixtures of formaldehyde-d_2 and H_2 as well as formaldehyde-d_2 and methane were photolyzed over a temperature interval in the region of 350°. Measurements of the HD/D_2 product ratios as a function of temperature, initial compositions and light intensity, give the activation energies and steric factors for $D + D_2CO \rightarrow D_2 + DCO$, the values $E = 4.8 \pm 0.6$ kcal, $P = 0.04$, and for $D + CH_4 \rightarrow HD + CH_3$ the values $E = 7.8 \pm 0.6$ kcal, $P = 0.025$. These are based on the values $E = 5.4$ kcal and $P = 0.11$ for the reaction $D + H_2 \rightarrow HD + H$.

t_i has been studied over the ranges: $1100° \leq T \leq 2600°K$, 1.3×10^{-5} $\leq [O_2] \leq 8.0 \times 10^{-4}$ mole/1, $0.25 \leq [H_2]/[O_2] \leq 5$, $0.004 \leq [O_2]/[Ar] \leq$ ≤ 0.20, and $5 \leq t_i \leq 500$ μsec. Agreement between incident and reflected shock experiments has been demonstrated. According to the branching chain mechanism known from explosion limit studies, t_i is governed by the rate of $H + O_2 \xrightarrow{k_1} OH + O$ according to: $2k_1[O_2]t_i = 2.303\ n$, where n is the number of decades by which [OH] increases between initiation and the end of the induction period. Th values of $[O_2]t_i$, which is nearly proportional to $1/k_1$, are summarized by: $\log_{10}([O_2]t_i)$ (mole 1^{-1} sec) $= -10.647 + (3966 \pm 625)/T$. The value $k_1 = 1.4 \times 10^9$ deduced at 1650°K from this work is combined with data near 800°K to give: $k_1 = 3 \times 10^{11} \exp(-17.5 \pm 3.\ kcal/RT)$

$(\text{mole}/1)^{-1}\ \text{sec}^{-1}$. The relation of these results to detonation experiments is discussed.

541.127 : 548.522

PRODUCTION OF CADMIUM SULPHIDE BY COEVAPORATION IN A VACUUM. See Abstr. 4101

ELECTROCHEMISTRY

541.133.1

5221. THE EXTRA MOBILITY OF H_3O^+ AND OH^- IONS IN WATER IN THE NEIGHBOURHOOD OF THE FREEZING POINT. R.Heise.
Z. Naturforsch., Vol. 13a, No. 7, 547-51 (July, 1958). In German.

Conductivity measurements on dilute solutions have enabled the temperature dependence of mobility to be measured in the range +10 to −6° C. The results are in good agreement with the theory of Gierer and Wirtz (Abstr. 5376/1950). J.M.Hough

541.135

5222. ELECTRODE POTENTIALS OF THE PALLADIUM–HYDROGEN SYSTEM. T.B.Flanagan and F.A.Lewis.
J. chem. Phys., Vol. 29, No. 6, 1417-18 (Dec., 1958).

Hydrogen was absorbed (in 2N H_2SO_4 through which the gas was bubbled) to a final concn. of 0.69 H/Pd (atomic ratio). During the absorption, electrode potentials and (relative) resistances were measured. All potentials differing from zero were positive w.r.t. Pt/H_2 and ultimately fall to zero. Palladium, charged with H_2 electrolytically, also gives an equilibrium value of zero indicating that there is no free energy difference between gas-phase charged and electrolytically charged Pd/H. W.Good

541.135.5

5223. THE ABNORMAL ANODIC DISSOLUTION OF CERTAIN METALS. M.Froment.
Bull. Soc. Franc. Elect., Vol. 8, 505-11 (Aug., 1958). In French.

The efficiency of the anodic dissolution of certain oxidizable metals, according to Faraday's Laws, is often greater than unity. The author describes a series of experiments on the anodic dissolution of aluminium and other metals in alcoholic magnesium perchlorate solutions under various conditions and including optical observation of the metal surface during dissolution. The abnormal dissolution is explained by the passage directly into solution of metal ions in a low valency state under the influence of intense surface electric fields. The strong reducing properties of these low valency state ions is demonstrated by the reduction of perchlorate to chloride ions. Eleven references. W.A.Walker

541.135.5 : 539.87

5224. EFFECT OF TORSIONAL STRESS ON THE ELECTRODE POTENTIAL OF COPPER. K.Nobe and W.F.Seyer.
J. appl. Phys., Vol. 29, No. 12, 1632-4 (Dec., 1958).

The e.m.f. of a galvanic cell which consisted of a stressed metal electrode and an unstressed metal electrode was measured. The experimental data showed that for low torsional stresses there was a parabolic relationship between the e.m.f. and the torsional stress. It was observed that the stressed electrode was more anodic with respect to the unstressed reference electrode in agreement with the majority of the previous investigations. Experimental data of e.m.f. and torsional stresses for B and S gauge 12, 14, and 16 hard-drawn copper wires are presented.

541.135.85

5225. ELECTRODE POTENTIAL OF GERMANIUM IN AQUEOUS SOLUTIONS AND THE EFFECT OF ILLUMINATION.
W.W.Harvey and H.C.Gatos.
J. appl. Phys., Vol. 29, No. 8, 1267-8 (Aug., 1958).

The effect of illumination is strongly dependent on the amount of dissolved oxygen in the electrolyte, and derived values of surface recombination velocity are also markedly dependent on the dissolved oxygen. It is believed that, with correct preparation, Ge surfaces in aqueous solutions are free of oxide, unlike Ge surfaces in air. C.A.Hogarth

PHOTOCHEMISTRY
RADIATION CHEMISTRY

541.14 : 537.531.7

THE PHOTOCHEMICAL BEHAVIOUR OF SENSITIZED SILVER BROMIDE AND SILVER CHLORIDE CRYSTALS ON IRRADIATION WITH X-RAYS. See Abstr. 4674

541.15

5226. A REMARK ON THE CHEMICAL KINETICS IN POLYMERS DURING IRRADIATION. T.Watanabe.
J. Phys. Soc. Japan, Vol. 13, No. 9, 1063-4 (Sept., 1958).

Studies of irradiated solid polymers by paramagetic resonance methods indicate that radical lifetimes may be long, and that the assumption of stationary radical concentrations is incorrect under these conditions. R.F.Barrow

541.15 : 538.69 : 538.27

PARAMAGNETIC RESONANCE STUDY OF IRRADIATED GLASSES OF METHANOL AND ETHANOL. See Abstr. 4817

541.15 : 537.56: 539.21

INTERNATIONAL CONGRESS OF RADIATION RESEARCH. See Abstr. 5164

DISPERSIONS . COLLOIDS . ADSORPTION

541.18 : 539.26

5227. SMALL-ANGLE X-RAY SCATTERING FROM SOLUTIONS OF AEROSOL OT IN NONAQUEOUS MEDIA. L.A.Siegel.
J. chem. Phys., Vol. 29, No. 5, 1091-6 (Nov., 1958).

The small-angle scattering of solutions of di(2-ethylhexyl) sodium sulphosuccinate in n-dodecane has been investigated for the concentration range 6-75%. The results agree with earlier work of Mattoon and Mathews and of Philippoff, in that a gradual decrease of scattered intensity with angle is found for the low concentrations, while a pronounced intensity maximum at a nonzero angle is found at the higher concentrations. Further, the data show that there is a gradual transition of the shape of the scattering curve between extremes as the concentration is varied. It is proposed that the observed changes in shape of the experimental curves represent the transition from gas-type to liquid-type scattering. The X-ray data are consistent with the existence of only one type of micelle over the entire concentration range. It is not necessary to postulate any special intermicellar arrangement to explain the high-concentration scattering maximum. While no detailed statement as to individual micellar structure can be made with the present data, they are consistent with an inverted structure in which the polar, more heavily scattering ends, are in the interior of the micelle. It is suggested that the exponential scattering observed in the low-concentration limit may have been overlooked in some earlier investigations of colloidal systems; conclusions drawn in these cases as to inability of the systems to form micelles because of molecular shape may be incorrect.

541.18.043

5228. SEDIMENTATION IN MULTICOMPONENT SYSTEMS. L. Peller.
J. chem. Phys., Vol. 29, No. 2, 415-20 (Aug., 1958).

The formalism of irreversible thermodynamics was employed to derive expressions for the sedimentation coefficients of the species in a multicomponent system in terms of experimentally accessible quantities. Equations are presented for certain limiting cases which may be encountered experimentally. The determination of the hydration of macromolecules by sedimentation methods is examined.

541.182 : 537.29

5229. EFFECT OF ELECTROSTATIC FIELDS ON THE ORIENTATION OF COLLOIDAL PARTICLES IMMERSED IN SHEAR FLOW. S.T.Demetriades.
J. chem. Phys., Vol. 29, No. 5, 1054-63 (Nov., 1958).

The orientation distribution function for rigid colloidal particles immersed in Couette flow with an electric field parallel to the velocity gradient is derived. Simple streaming birefringence experiments with variable or constant electric fields can be devised to test this theory, which promises to yield a new method for measuring some geometrical and physical properties of colloidal particles.

541.182

5230. THE DETERMINATION OF THE PARTICLE SIZE DISTRIBUTION OF AEROSOLS BY PRECIPITATION OF CHARGED PARTICLES. V.G.Drozin and V.K.La Mer.
J. Colloid Sci., Vol. 14, No. 1, 74-90 (Feb., 1959).

The method is based on the measurement of the macroscopic properties of a large number of particles. The electric current carried by a large number ($\sim10^8$) of particles charged in a corona discharge and precipitated in an electric field, when measured as a function of precipitation time, is one such property. The number of charges acquired by particles is a single-valued function of particle size. From a knowledge of this function and measured values of current (or accumulated charges) versus time, the size distribution curve can be determined. The entire procedure, including the necessary calculation, takes about 20 min and requires relatively inexpensive equipment. All experiments were carried out with particles in the submicron range, the most difficult and at present the most important range. The size distribution of particles smaller than 0.2 μ radius could not be determined by this method, since their charging follows another law. Theoretically it is possible to overcome this difficulty.

541.183

5231. ADSORPTION OF OXYGEN AND CARBON MONOXIDE ON TUNGSTEN. R.E.Schlier.
J. appl. Phys., Vol. 29, No. 8, 1162-7 (Aug., 1958).

The adsorption of oxygen, carbon monoxide, and nitrogen on a tungsten ribbon filament at 300° K was measured by means of the flash filament technique. An omegatron r.f. mass spectrometer was used to measure pressure. It is shown that oxygen pressures cannot be measured satisfactorily with ionization gauges of the hot-tungsten-filament type. The total amounts of gases adsorbed by tungsten are 5.7×10^{14} molecules/cm^2 for oxygen, 5.8×10^{14} for carbon monoxide, and 1.8×10^{14} for nitrogen. The sticking probabilities of these gases on the uncovered surface are 0.65 for oxygen, 0.62 for carbon monoxide, and 0.42 for nitrogen. All of the carbon monoxide and nitrogen desorb from the heated filament as the gases CO and N_2; less than 1 per cent of the oxygen desorbs as O_2. The filament pumps oxygen at a rate of 9 litres (cm^{2}sec) at temperatures above 2000° K.

541.183

5232. CONTROL DEVICE FOR AN AUTOMATIC HIGH-PRESSURE SORPTION BALANCE. P.Cannon.
Rev. sci. Instrum., Vol. 29, No. 12, 1115-17 (Dec., 1958).

A novel photoresistive cell was developed which will sense the position of a beam of light. This cell was used in a servo network to null the arm of an electromagnetic sorption balance. The balance was enclosed in a metal high-pressure shell and was not observable in any conventional way. Details of the construction of the cell are given.

541.183.55

5233. LIQUID-LIKE LAYERS IN THE ADSORBED FILM OF H_2O ON GLASS. K.Kawasaki, K.Kanou and Y.Sekita.
J. Phys. Soc. Japan, Vol. 13, No. 2, 222-3 (Feb., 1958).

The adsorption isotherm of water vapour and the d.c. surface conductivity were measured for each of four samples of glass. The results indicate that the innermost layer(s) is (are) immobile while the outer layers are mobile. W.Good

541.183.56

5234. PROPERTIES OF HYDROGEN CHEMISORBED ON TUNGSTEN. J.Eisinger.
J. chem. Phys., Vol. 29, No. 5, 1154-60 (Nov., 1958).

The sticking probability of hydrogen on a single crystal tungsten ribbon was measured as a function of the number of adsorbed ator The work function of the same ribbon was measured by a photoele tric technique. The results indicate that during the initial fast chemisorption characterized by an almost constant sticking proba ility of approximately 0.2 the work function rose from 4.54 eV for the clean surface to a maximum value of 5.0 eV for the covered s face. The maximum coverage at room temperature was $(7.5 \pm 1.0) \times 10^{14}$ cm^{-2}. Evidence for two stages of adsorption is presented and experimental techniques are described.

541.183.5

5235. APPLICATION OF CHARGE-TRANSFER THEORY TO THE HEATS OF ADSORPTION OF THE INERT GASES ON CHARCOAL. D.G.Tuck.
J. chem. Phys., Vol. 29, No. 4, 724-6 (Oct., 1958).

Adsorption is considered from the viewpoint of charge-transf no-bond complex formation, and interaction integrals are calculat from the heats of adsorption at effectively zero coverage. The numerical values obtained in this way are compatible with similar data in the literature. It is shown that the linear relationship previously reported between the heat of adsorption of the inert gas on charcoal and the polarizabilities of the gases can be satisfactor derived on the basis of this theory, and arises to a large extent fr the comparatively high ionization potentials of these elements.

CHEMICAL ANALYSIS

545.8 : 539.1.0

NITROGEN DETERMINATION IN BULK MEDIA USING GAMMA RAY SPECTROMETER AT HIGH COUNTING RATES.
See Abstr. 4882

545.8

5236. PRINCIPLES OF AN INSTRUMENT FOR PRECISION COLORIMETRY (OF SOLUTIONS). J.Skotnicky.
Exper. Tech. der Phys., Vol. 2, No. 3, 97-109 (1954). In German.

A theoretical treatment of the sensitivity attainable in the visual and photoelectric colorimetry of chemical solutions indicates that the extinction coefficient, over the range generally needed, can be measured to an accuracy of about 3 per cent. The two methods are compared and a photoelectric instrument is described. This depends on compensation, so that the linearity of the cell is immaterial and the accuracy is that of the scale of a variable aperture diaphragm. J.W.T.Walsh

545.824 : 539.262 : 537.533

RESOLUTION OF ELECTRON PROBE MICROANALYSERS.
See Abstr. 4701

545.844

5237. A DETECTOR FOR USE WITH CAPILLARY TUBE COLUMNS IN GAS CHROMATOGRAPHY. J.E.Lovelock.
Nature (London), Vol. 182, 1663-4 (Dec. 13, 1958).

The capillary column, 125 ft long and 0.01 in. in diameter, is coated with a thin layer of squalane as the stationary phase. An efficiency of 30000 theoretical plates was observed in the separation of a mixture of hydrocarbon vapours using a load of 0.3 μg. The detector, which is described, consists of a small chamber into which the vapour from the column is led. Metastable rare-gas atoms (argon) produced by an ionizing radiation in the chamber ionize the vapour molecules and so give rise to an ionization current which is measured. The dimension of the sensing volume is 1 μl. W.Good

CRYSTALLOGRAPHY

548 : 535.525

5238. OPTICAL METHOD FOR DETERMINING THE C AXIS OF RUBY BOULES. R.D.Mattuck and M.W.P.Strandberg.
Rev. sci. Instrum., Vol. 30, No. 3, 195-6 (March, 1959).

A simple method is described for locating the C axis of an uncut ruby crystal. The procedure involves measurement of the angular position of the ruby for zero light transmission when it is placed between crossed polarizer and analyser. The precision is ±1°.

548.0 : 535.5

5239. GROWTH AND EXTINCTION OF GUANIDINE ALUMINUM SULFATE HEXAHYDRATE CRYSTALS. A.Nishioka and K.Sekikawa.
J. Phys. Soc. Japan, Vol. 13, No. 10, 1237-8 (Oct., 1958).

Some curious optical properties of growing single crystals are reported. These properties are not expected from X-ray analysis results. B.T.M.Willis

548.1 : 51

5240. A METHOD FOR EVALUATING LATTICE SUMS. A.A.Maradudin and G.H.Weiss.
Canad. J. Phys., Vol. 37, No. 2, 170-3 (Feb., 1959).

A rapidly convergent method for evaluating a certain class of lattice sums by the use of asymptotic series is presented, and the method is illustrated by applying it to the evaluation of lattice sums previously studied by Benson and Schreiber.

548.2

5241. PREPARATION AND X-RAY CRYSTALLITE-SIZE DETERMINATION OF GLOSSY CARBON, GREY CARBON, AND SOOT. G.Becherer and B.Thiele.
Exper. Tech. der Phys., Vol. 4, No. 2, 50-62 (1956). In German.

The method of deposition of various forms of carbon by thermal dissociation of heptane is described. From measurements of widths of Debye—Scherrer rings it is concluded that all three forms have particles of about 30 A diameter and 20 A thickness. A.R.Stokes

548.2 : 539.231

5242. CRYSTAL GROWTH ON CATHODE SPUTTERED COPPER FILMS BY PAIRS OF DOUBLE SPIRAL MECHANISMS ANALOGOUS TO FRANK—READ SOURCES. E.B.Henschke.
J. appl. Phys., Vol. 29, No. 10, 1495-1502 (Oct., 1958).

Unique crystal growth patterns with closed loops, partly concentric and partly eccentric, with very large step heights between the ledges were observed on microblisters of copper films sputtered onto glass substrate. While the primary cause for the generation of the blisters is explained as due to diffusion-oil deposits present on the glass substrate and to heat from secondary electrons released by the target producing a high vapour pressure underneath the sputtered film, the generation of the loop patterns on the flat circular surface of the blisters is considered to be caused by alternative slips induced by the inside pressure which affect a triangular part of the {111} surface with two sides of {111} slip planes, one in radial <110> direction and the other in a <110> direction along the rim of the blister. Two alternately generated monatomic radial steps on the flat part of the blister produce two superposing spirals of opposite sense each due to one half of two Frank—Read sources and create by repetition of this process the observed patterns with very large step heights of the ledges.

548.23

5243. THE CELLULAR SUBSTRUCTURE OF ZINC SINGLE CRYSTALS PREPARED BY THE CZOCHRALSKI METHOD. M.Boček, P.Kratochvíl and M.Valouch.
Czech. J. Phys., Vol. 8, No. 5, 557-62 (1958).

The dependence of the size of cellular substructure on the rate of growth and the temperature gradient of metal single crystals grown from the melt by the Czochralski or Bridgmann method is the same. The dependence of the size of elongated cells is of the same type. A hypothesis on the mechanism of production of elongated cells is proposed, with particular reference to the influence of orientation of single crystals.

548.24

5244. CONSECUTIVE OBSERVATIONS ON CRYSTAL TWIN INTERSECTIONS. H.Kiho and S.Maruyama.
J. Phys. Soc. Japan, Vol. 13, No. 3, 320 (March, 1958).

It is not easy to distinguish between the crossed twin and the crossing twin by inspection of the misfits of the twin bands. Consecutive production of twin lamellae in thin cleaved strips of Bi single crystal has shown how each twin reacts at the intersection. Four plates illustrate different intersections. W.Bardsley

548.5

5245. WHISKER GROWTH OF ALKALI HALIDES. G.Matthäi and G.Syrbe.
Z. Naturforsch., Vol. 12a, No. 2, 174 (1957). In German.

Whiskers of NaCl, KCl, KBr, KI and CsCl up to 10 mm long and several hundredths of a mm thick were grown on cubic crystal faces which had been in contact with a paraffin substrate. J.Franks

548.5

5246. POTASSIUM CHLORIDE WHISKERS IN ELECTROLYTIC CELLS. A.E.Simchen.
Z. Naturforsch., Vol. 12a, No. 8, 672 (1957).

Comments on the preceding abstract.

548.5 : 669.09

ELECTROLYTIC SAW FOR METAL CRYSTALS. See Abstr. 4192

548.52

5247. A PROPOSED EXPLANATION OF IRRADIATION GROWTH OF URANIUM. R.R.Hasiguti, H.Sakairi and T.Sugai.
J. Phys. Soc. Japan, Vol. 13, No. 10, 1233-4 (Oct., 1958).

Pugh's theory of the growth of α-uranium crystals under neutron irradiation is extended. It is proposed that (130)[310] twinning takes place through the stresses originating from thermal spikes, and that the resultant twinning stresses are relieved by precipitation of vacancies along [100] edge dislocations and of interstitials in the (010) plane. Irradiation growth does not occur at low temperatures because of the difficulty of diffusion and precipitation, and at high temperatures because of the difficulty of twinning. B.T.M.Willis

548.52 : 537.311.33

RELATION BETWEEN CRYSTALLIZATION AND ELECTRICAL RESISTANCE OF SELENIUM FILMS. See Abstr. 4592

548.538

5248. ELECTRON DIFFRACTION STUDY OF EPITAXIAL GROWTH OF SILVER DEPOSITS ON SODIUM CHLORIDE CRYSTALS. A.Goswami.
J. sci. industr. Res., Vol. 17B, No. 8, 324-6 (Aug., 1958).

The author has both repeated and reinterpreted the experiments of Pande (J. sci. industr. Res., Vol. 17B, No. 1, 1-4, Jan., 1958). The existence of a new hexagonal close-packed form of silver with $c/a = 1.60$, claimed by Pande, is disputed. R.Bullough

548.54

5249. SOME OBSERVATIONS ON GERMANIUM BICRYSTALS. M.Kikuchi and S.Iizima.
J. Phys. Soc. Japan, Vol. 13, No. 3, 319 (March, 1958).

The preponderance of [111] or [100] in a germanium bicrystal pulled from the melt, using [111] and [100] seeds in contact along the ⟨110⟩ direction, is stated to depend upon the orientation of the [111] seed. A.W.Penn

548.55

5250. PRODUCTION OF LARGE METALLIC SINGLE CRYSTALS AT HIGH TEMPERATURES. W.Stephan.
Exper. Tech. der Phys., Vol. 5, No. 3, 97-108 (1957). In German.

A vacuum oven is described for producing large metallic single crystals at temperatures up to 1600°C by the Bridgman—Quimby technique. A molybdenum heating element was used together with a crucible of sintered corundum. The production of single crystals of Cu, Ni, Fe—Ni, Cu—Ni, Fe—Si, Co and alnico is described. B.T.M.Willis

548.574

5251. THE SUB-STRUCTURE OF CRYSTALS OF SILICON—IRON ALLOY. B.Šesták.
Czech. J. Phys., Vol. 8, No. 1, 90-3 (1958).

After electrolytic polishing and etching, a network of boundaries between mosaic blocks was observed on the surface of single crystals prepared from the melt. Some of the boundaries are formed by a number of distinguishable pits, also found singly outside the boundary. An explanation is given on the basis of the concept that the pits are etched points of intersection of edge dislocations with the surface of the crystals.

548.574

5252. ETCH FIGURES ON SILICON IRON. F.Kroupa.
Czech. J. Phys., Vol. 8, No. 2, 186-95 (1958).

Steps, which at some points of the (110) planes become spiral pits, were obtained on the surface by electrolytic etching. The height of the steps, which was from about 10 to 1000 A, was measured by multiple beam interferometry. An explanation of the step-like etching is proposed and some of the mechanisms, which can lead to the production of etch spirals with the above height of the steps, are given.

X-RAY CRYSTALLOGRAPHY

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also the Section entitled "STRUCTURE OF SOLIDS".

548.732

5253. X-RAY SCATTERING BY BUNDLES OF CYLINDERS. R.E.Burge.
Acta cryst., Vol. 12, Pt 4, 285-9 (April, 1959).

The effects of interparticle interference on the low-angle scattering by a bundle of paralled cylinders in close-packed hexagonal array are calculated. The application of the results to the elucidation of the sizes of coherent hexagonal aggregates from X-ray scattering measurements obtained from both solid samples and solutions of long chain molecules is discussed; the calculations may also be of value in the interpretation of light-scattering results from similar solutions.

548.732 : 539.2

5254. ELASTIC WAVE VELOCITY EFFECT ON TEMPERATURE DIFFUSE SCATTERING IN CUBIC POWDERS. A.Paskin.
Acta cryst., Vol. 12, Pt 4, 290-4 (April, 1959).

A simplifying assumption made in previous calculations of temperature diffuse scattering (TDS) for cubic powders is that all elastic waves have the same average velocity. In practice, the longitudinal velocity is found to be about twice the magnitude of the transverse velocity. The effect of such velocity differences is considered for the one - and two phonon contribution to TDS. It is found that the major effect in both the one and two phonon contribution is to sharpen the peaking of TDS in the vicinity of the Bragg peaks. For the most part, there is a decrease of the magnitude of TDS in the valleys between Bragg peaks and an increase in the magnitude of TDS at the Bragg peaks over the results of the previous calculations. Thus, the observed magnitude of TDS between Bragg peaks is decreased, in accord with comparisons of earlier theory with experiment. The contribution of TDS to the apparent measured integrated intensity is found to be larger than earlier estimates and thus increases the importance of correcting for the TDS contribution to measured Bragg intensities.

548.735 : 539.2

5255. SOME RELATIONS BETWEEN CRYSTAL STRUCTURES. II. STRUCTURES WITH COMMENSURABLE POSITION CORRELATION OF PARTNERS. K.Schubert.
Z. Naturforsch., Vol. 11a, No. 12, 999-1010 (1956). In German.

For Pt I see Abstr. 9981 (1957). Structures of Cu_2Mg, $CaCu_5$, $NaZn_{13}$ and related alloys are considered from the point of view of position-correlation of valence electrons. A.R.Stokes

548.735 : 539.2

5256. SOME RELATIONS BETWEEN CRYSTAL STRUCTURES. III. UNIAXIAL STRETCHING OF CRYSTAL STRUCTURES ON INCREASE OF ELECTRON CONCENTRATION. K.Schubert.
Z. Naturforsch., Vol. 12a, No. 4, 310-19 (1957). In German.

Discusses various examples of different kinds of bonds in metallic and non-metallic phases, in which a change in the nature of constituents brings about a special structural change which consists in a predominantly uniaxial stretching of crystal structures when the concentration of electrons increases. As regards the position of the atoms in the structure, this appears to be of secondary importance. F.Lachman

548.735 : 539.2

5257. SHADOWS OF DISLOCATION LINES IN X-RAY DIAGRAMS. G.Borrmann, W.Hartwig and H.Irmler.
Z. Naturforsch., Vol. 13a, No. 5, 423-5 (May, 1958). In German.

The region of lattice distortion in the neighbourhood of a dislocation line is large enough to cast a shadow under those conditions, previously discussed by Borrmann, in which a diffracted X-ray be passes through a single crystal with anomalously low absorption. Examples of such shadows are given, obtained with a single crysta of Si. J.Thew

548.735.2 : 536.41

CELL CONSTANTS OF TRIGONAL K, Li, Ag AND Na NITRATES. See Abstr. 4519

548.736

5258. X-RAY MEASUREMENT OF THE DISTRIBUTION OF ELECTRONS IN IRON AND COPPER. B.W.Batterman.
Phys. Rev. Letters, Vol. 2, No. 2, 47-8 (Jan. 15, 1959).

Careful intensity measurements were made of X-ray reflectio from metallic powders of Fe and Cu, using monochromatic Fe K_α radiation, from which the atomic scattering factors were derived. Extinction effects were eliminated by the use of cold-pressed briquettes, on the assumption that such effects are negligible for cold-worked metals. From the atomic scattering factors it was deduced that, to an accuracy of about one 3d electron, the number of electrons in metallic Fe and Cu is the same as that in the free atom. This contrasts with the value of (2.3 ± 0.3) 3d electrons for Fe reported by Weiss and De Marco (Abstr. 3583/1958) from single-crystal measurements. J.Thewli

548.736.

5259. ON THE DIAGRAM OF STATE OF THE SYSTEM HYDROGEN—DEUTERIUM.
V.S.Kogan, B.G.Lazarev and R.F.Bulatova.
Zh. eksper. teor. Fiz., Vol. 34, No. 1, 238-40 (1958). In Russian.

X-ray crystallographic studies have been made on the H_2—D_2 system at 4.2°K. The diagrams from H_2 show two lines, at about 3.15 and 2.79 A. The diagrams from D_2 give only one line, at 2.84 A. At compositions between 20 and 80% H_2 by volume, both lattices occur, but with slightly changed parameters. Thermal analysis established the solidus curve at 16.4°K. A.L.Mackay

548.736.

5260. ON THE STRUCTURE OF THIN SALT FILMS CONDENSED AT LOW TEMPERATURES. III. SYSTEMS OF TWO ALKALI HALIDES. H.J.Queisser.
Z. Phys., Vol. 152, No. 4, 507-20 (1958). In German.

A continuation of the work described in Abstr. 2560 (1956). The structure of films composed of two alkali halides has been investigated by X-ray diffraction. Phase diagrams are given for the systems KCl/NaCl, CsCl/KCl, and CsCl/NaCl. CsCl and NaCl are immiscible and a new intermediate phase is reported. A.E.De Barr

548.736.5

5261. CRYSTAL STRUCTURE OF COPPER FLUORIDE DIHYDRATE, $CuF_2.2H_2O$. S.Geller and W.L.Bond.
J. chem. Phys., Vol. 29, No. 4, 925-30 (Oct., 1958).

The crystal structure was determined from single crystal X-ray data. The monoclinic unit cell, space group $C_{2h}(3)$-I2/m, with a = 6.416, b = 7.397, c = 3.301, all ±0.005 A, β = 99.6 ± 0.1°, contains two formula units, and the positions of the atoms are given. Comparisons are made with other Cu(II) halide compounds and the observed antiferromagnetism is discussed. The morphology and optic axes were also investigated.

548.74

5262. A NOTE ON THE MAGNETIC INTENSITIES OF POWDER NEUTRON DIFFRACTION. G.Shirane.
Acta cryst., Vol. 12, Pt 4, 282-5 (April, 1959).

General intensity formulae of powder neutron diffraction lines are given for magnetic structures with a single-spin-axis as a function of the spin direction with respect to the crystallographic axes. If one disregards the vector properties of spins and assigns a positive or negative scattering amplitude to the magnetic atoms, these scalar scatterers constitute a "configurational symmetry" of the magnetic structure. When this symmetry is tetragonal, rhombohedral or hexagonal, the powder intensities cannot provide more information than the angle between the spin direction and the unique axis of the structure. The ambiguity of spin directions in α Fe_2O_3, NiAs and MnO type structures is discussed.

548.74 : 532.74

ATOMIC DISTRIBUTION IN LIQUID AND SOLID NEON AND SOLID ARGON BY NEUTRON DIFFRACTION. See Abstr. 4346

GEOPHYSICS

550.312

5263. THE MEASUREMENT OF THE GRAVITY DIFFERENCE BETWEEN TWO POINTS WITH A STATIC GRAVIMETER.

F.Gassmann.

Mitt. Inst. Geophys. E.T.H. Zürich, No. 35, 24 pp. (Jan., 1959).
In German.

Describes the method used in Switzerland of setting up a network of gravity stations.

J.M.Hough

550.312

5264. GRAVITY FORMULAS UTILIZING CORRELATION WITH ELEVATION.

W.M.Kaula.

Trans Amer. Geophys. Un., Vol. 39, No. 6, 1027-33 (Dec., 1958).

Solutions for the first two terms of the standard gravity formula

$$\gamma_e(1 + \beta \sin^2 \phi)$$

were made, all based on the assumption that the gravity anomalies in areas without observations will average the same as observed values of the same elevation. The solution by the method considered theoretically best yields

$$\gamma = (978040.4 \pm 1.3)[1 + (0.0053014 \pm 0.0000030) \sin^2 \phi - 0.0000059 \sin^2 2\phi],$$

and

$$f = 1/298.15 \pm 0.26.$$

The coefficients of the fourth and sixth degree zonal harmonics were also computed and used to estimate how much a flattening found from satellite motion would differ. For example, it is estimated that an orbit approximating that of 1958 β would give $f = 1/298.00$.

550.341

5265. EFFECTS OF A LIQUID CORE ON THE PROPAGATION OF SEISMIC WAVES.

G.Duwalo and J.A.Jacobs.

Canad. J. Phys., Vol. 37, No. 2, 109-28 (Feb., 1959).

Effects of a spherical cavity in an infinite, homogeneous, isotropic elastic solid, containing non-viscous compressible liquid, on the propagation of elastic waves are investigated mathematically. The waves emitted by a simple harmonic point source in the solid are of the types known as SH and P in seismology. The discussion is restricted to the case $ka \gg 1$ ($ka = 2\pi$ cavity radius/wavelength). Series solutions are transformed into contour integrals by Watson's method. Evaluation of these by the method of residues results in expressions describing the P and S components of the diffracted waves.

550.38 : 517.564.4

5266. THE SPHERICAL HARMONIC DEVELOPMENT OF THE GEOMAGNETIC FIELD, EPOCH 1945, TRANSFORMED INTO RECTANGULAR GEOMAGNETIC COORDINATE SYSTEMS.

B.Hultqvist.

Ark. Geofys., Vol. 3, Paper 3, 53-61 (1958).

Transformed with the z-axis in the direction opposite to that of the earth's dipole and with the x-axis in the 36 geomagnetic meridian planes having a geomagnetic longitude of 0°, 10°, 20° ... 350° respectively.

550.385 : 523.75

STORM-PRODUCING PROBABILITY OF FLARES. See Abstr. 4221

550.9 : 535.377

MEASUREMENTS OF THERMOLUMINESCENCE AS A MEANS OF INVESTIGATING THE THERMAL AND RADIATION HISTORY OF NATURAL MINERALS AND ROCKS. See Abstr. 4479

ATMOSPHERE . IONOSPHERE

551.510.3

5267. DENSITIES AND TEMPERATURES OF THE UPPER ATMOSPHERE INFERRED FROM SATELLITE OBSERVATIONS.

G.F.Schilling and T.E.Sterne.

J. geophys. Res., Vol. 64, No. 1, 1-4 (Jan., 1959).

Surface observations of artificial earth satellites permit the inference of upper atmosphere densities from changes in the orbital elements caused by drag. The atmospheric density between some 180 to 400 km altitude appears to be appreciably higher, on the average, than was usually thought before satellite data became available. In order to be consistent with the observed phenomena, the atmospheric temperature at or below these altitudes must also be higher than that given by a number of model atmospheres.

551.510.535

5268. ANNUAL WAVE IN THE WORLD-WIDE F-REGION IONIZATION.

B.N.Bhargava.

Indian J. Meteorol. Geophys., Vol. 10, No. 1, 69-72 (Jan., 1959).

An analysis of squares of noon median F2 layer critical frequencies for a 3-year period was made in order to derive the latitude variation of the annual effect in the electron densities and its relation to average F2 layer ionization. The results indicate that the annual component R_1 varies with the latitude in a manner very nearly similar to that of the steady ionization R_0, and that for a given value of R_0 for any latitude, R_1 can be derived approximately from a linear relationship of the type

$$R_1 = 0.3\, R_0 - 4.5.$$

A similar analysis of 9-year data for precise phase and amplitude of the annual component for a pair of stations yields a value of R_1 which is of the same order of magnitude as R_0 and which attains a maximum around the epoch of minimum sun–earth distance.

551.510.535

5269. DYNAMICAL STRUCTURE OF THE IONOSPHERIC F2 LAYER.

T.Shimazaki.

J. Radio Res. Lab. (Tokyo), Vol. 4, 309-32 (July, 1957).

An investigation has been made of the effect of ambipolar diffusion on the ionospheric F2 regions above 300 km. General formulae of diffusion velocity and its divergence of the electron–ion gases are developed for the atmospheric model with a linear temperature (or scale height) gradient. Then, applying these formulae to various assumed distributions of electron density, the author calculated by numerical methods the change in the N–z distribution under the influence of diffusion, attachment, and ionization. The result shows that diffusive equilibrium distribution of electron–ion gases is well established in the regions above 300 km within an hour or so, much shorter than the periods of temperature- or tidal-variations (one day or a half). A possibility is discussed of estimating the particle density at great heights by observing the downward diffusion velocity and its height dependency of the non-equilibrium ionized regions in the ionosphere. Numerical calculations are used to find the effects of various non-uniform motions due to diffusion, thermal- or tidal-variations on daily variations in the F2 layer. A method of solving the problem was worked out so that the electron density distribution can return back every 24 hours regardless of non-recurrent motions of each part resulting from several causes. The comparison of calculated and observed variations shows that the Bradbury model is better than the Chapman's in every respect. Special emphasis is placed upon the fact that the effect of non-uniform semi-diurnal vertical drift velocities with height gradient of both amplitude and phase is very important except near the equator.

551.510.535

5270. THE DIURNAL AND ANNUAL VARIATIONS OF f_0F2 OVER THE POLAR REGIONS.

S.C.Coroniti and R.Penndorf.

J. geophys. Res., Vol. 64, No. 1, 5-18 (Jan., 1959).

Critical frequency data, f_0F2, are analysed in the polar regions for the period 1954 to summer 1957. The diurnal variation is largest in winter and smallest in summer. In winter little or no diurnal variation occurs north of 75°. The amplitude increases southward up to 11 Mc/s at 60°N with a minimum around 07 h and a maximum between 12 h to 14 h. The daily variation is fairly symmetrical around the maximum. The pronounced daily variation lasts from fall through winter till spring. The annual variation shows a regular behaviour, with steep gradients occurring around sunrise and sunset throughout the year. The latitudinal differences are small in summer, of the order of 1 Mc/s or less between 60° and 80°N, but large in winter. The lines of equal f_0F2 seem to fall between the geographic and geomagnetic latitude circles. The diurnal variation in the Antarctic is different from that in the Arctic during the southern summer (November to February) because a dip occurs around noon.

551.510.535

5271. ON DIFFERENCES OF f_0F2 BETWEEN JUNE AND DECEMBER VIEWED FROM A WORLD-WIDE STANDPOINT. M.Mambo.
J. Radio Res. Lab. (Tokyo), Vol. 4, 59-71 (Jan., 1957).

The seasonal variations of f_0F2 have so far been treated by comparison of data obtained at Watheroo. In this paper a report is given on a world-wide basis.

551.510.535

5272. EFFECT OF THE S_q CURRENT SYSTEM ON THE IONOSPHERIC E AND F1 REGIONS. T.Shimazaki.
J. Radio Res. Lab. (Tokyo), Vol. 4, 37-48 (Jan., 1957).

The discrepancy between the practical variation in f_0E or f_0F1 and the Chapman theory was examined in detail. The result shows that the F1 layer varies in a more regular manner than the E layer, and that the discrepancy in the E layer may be attributed partly to the effect of the scale height gradient. The principal cause certainly lies in the effect of S_q overhead current system. The non-uniform motion of vertical drift velocity produced by this effect is discussed, as well as the recombination coefficient and the scale height gradient in these regions.

551.510.535

5273. [SEASONAL] NON-CHAPMANLIKE VARIATIONS IN THE IONOSPHERIC E AND F1 LAYERS. (EFFECT OF THE Sq CURRENT SYSTEMS II). T.Shimazaki.
J. Radio Res. Lab. (Tokyo), Vol. 5, 35-56 (Jan., 1958).

Extension of previous work (see preceding abstract). In non-equinoctial months, such as June or December, the f_0E observed at any χ (the solar senith distance) in the winter hemisphere is much larger than that observed at the same χ in the summer hemisphere. It is concluded that this asymmetrical distribution in the summer and winter hemispheres is due to the difference of the Sq current effect in the E layer between these two hemispheres. This is conceivable from the fact that the Sq current system develops more strongly in summer than in winter. On the other hand, a somewhat similar asymmetrical distribution can be observed in the F1 layer, but detailed examinations show that this can be explained satisfactorily by the temperature difference (about 20% as average) between the two hemispheres.

551.510.535 : 523.746

5274. A METHOD OF DETERMINING THE CORRELATION BETWEEN f_0 F2 AND SUNSPOT NUMBER. H.Shibata.
J. Radio Res. Lab. (Tokyo), Vol. 5, 65-73 (Jan., 1958).

551.510.535

5275. EXPERIMENTAL INVESTIGATIONS OF THE IONOSPHERIC E-LAYER. B.J.Robinson.
Rep. Progr. Phys., Vol. 22, 241-79 (1959).

Discusses the recent information gained about the E-layer of the ionosphere by various experimental techniques. The basic information is provided by penetration-frequency measurements made from routine pulse soundings, giving a general picture of the variation of the ionization during the day, with season and with latitude, as well as the effect of changing solar activity and of the magnetic current system. Special radio-reflection experiments to measure height changes have yielded important results, particularly concerning tidal movements. The detailed structure of the layer has also been deduced from high-resolution pulse soundings. Independent information about the structure of the layer has been determined directly using rockets, and shows marked differences from the structure deduced from ground observations. Observations with high-resolution ionosondes reveal that the reflections from the E-region are often very complex, and this introduces uncertainties in the identification of the characteristics of the normal E-layer. A brief discussion is given of observations of fine-structure in the layer. Rocket measurements of solar radiations and of the atmospheric composition have made it possible to predict the distribution of ionization in the E-layer; this prediction is in quite good agreement with the distribution determined from accurate soundings. Observations of changes in the ionization during solar flares and radio fade-outs are described.

551.510.535 : 621.39

5276. HORIZONTAL MOVEMENTS IN THE F-LAYER OF THE IONOSPHERE. V.V.Tolstov.
Radiotekhnika i Elektronika, Vol. 3, No. 6, 760-3 (1958). In Russi

The results of an experimental study of the diffraction patter of radio waves reflected from the F-layer carried out between October 1955 and April 1956 are described. The results show tha a regular drift of ionization inhomogeneities exists with velocities from 10 to 200 m/sec and above. The predominant direction of drift before noon is to the west and after noon to the east.
R.C.Gla

551.510.535 : 538.566.3 : 621.39

THE ROLE OF TURBULENT MIXING IN SCATTER PROPAGATION. See Abstr. 4854-5

551.510.5

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See als the Section entitled "ELECTROMAGNETIC WAVES AND OSCILLATIONS".

551.52

5277. ON THE COMPUTATION OF GLOBAL RADIATION FROM RECORDS OF SUNSHINE. A.Ångström.
Ark. Geofys., Vol. 2, Paper 22, 471-9 (1956).

A detailed discussion of the results obtained from a comparis of direct records of the intensity of sun and sky radiation f(Q) with those of hours of sunshine f(S) at the same site, and at varying altitudes above sea-level. The constants, a, a', and b, b', in the gener ized interpolation formulae, $Q = Q_A(a + b\,.S/S_0)$, and $Q = Q_0(a' + b'\,.S/S_0)$ are computed, and tabulated for a variety of locations throughout the world. With due precautions, the interpolation formulae may be used in conjunction with standard sunshine records from large numbers of additional stations to give satisfactory synoptic plots of the world-wide radiation climate. D.R.Barbe

551.521.32

5278. THE BLUE AIRGLOW SPECTRUM. J.W.Chamberlain.
Astrophys. J., Vol. 128, No. 3, 713-17 (Nov., 1958).

High-dispersion spectra of the airglow covering the region 3700-4900 A are discussed in terms of possible identifications. A number of Herzberg bands of O_2 appear in this region; a new system of O_2 bands, ${}^3\Delta_u \rightarrow {}^1\Delta_g$, may explain several weaker features. An airglow continuum is not important in the region around 4000 A and shortward, but longward of 4500 A a real continuum appears to be o dominating brilliance.

551.57

5279. CLOUD PHYSICS. H.G.Houghton.
Science, Vol. 129, 307-13 (Feb. 6, 1959).

Review article for non-specialists on current research problems of nucleation, growth, and precipitation of water particles.

551.594.12

5280. ON SOME RELATIONS BETWEEN ATMOSPHERIC IONS AND NATURAL RADIOACTIVITY. S.Okabe.
Mem. Coll. Sci. Univ. Kyoto A, Vol. 28, No. 3, 231-52 (Sept., 1957).

551.594.14

5281. PRESENCE OF ^{57}Co IN THE ATMOSPHERE. L.Marquez, N.L.Costa and I.G.Almeida.
Nuovo Cimento, Vol. 11, No. 1, 111-12 (Jan. 1, 1959).

Describes the way in which rainwater was concentrated to obtain a detectable activity of the order of 0.02 d.p.m./litre. The bulk of the Co^{57} is due to thermonuclear tests. J.M.Hough

BIOPHYSICS

PHYSIOLOGICAL PHYSICS

591.485 : 612.85

LOCALIZATION OF AURAL HARMONICS ALONG THE BASILAR MEMBRANE OF GUINEA PIGS. See Abstr. 4181

612.1 : 534.23

ABSORPTION OF SOUND ARISING FROM THE PRESENCE OF INTACT CELLS IN BLOOD. See Abstr. 4390

612.8

5282. A SYSTEM OF COUPLED OSCILLATORS AS A FUNCTIONAL MODEL OF NEURONAL ASSEMBLIES. V.Braitenberg, E.R.Caianiello, F.Lauria and N.Onesto.
Nuovo Cimento, Vol. 11, No. 2, 278-82 (Jan. 16, 1959).

Proposal of a model which promises to share with the living nervous system the properties of economy, capacity to recognize similarity, character of wholeness (Gestalt).

612.843

5283. CHARACTERISTICS OF A MODEL RETINAL RECEPTOR STUDIED AT MICROWAVE FREQUENCIES. J.M.Enoch and G.A.Fry.
J. Opt. Soc. Amer., Vol. 48, No. 12, 899-911 (Dec., 1958).

A simplified microwave model of the human eye was constructed in order to study the characteristics of a model retinal receptor. A technique devised by O'Brien (Abstr. 2321/1952) was employed. The model receptor was a truncated cone of polystyrene-foam. This was fitted into a horn which transmitted the energy to a detection unit. The relative sensitivity of the model receptor was determined when it was irradiated by a point source and when it was placed at several different positions in a diffraction pattern at or near the Gaussian image point. The directional sensitivity was studied by pointing it in different directions. In addition, interaction effects between neighbouring receptors were studied. Two different wavelengths have been used. It was found that there were differences in energy absorbed by the detector unit when the model was irradiated by the point source and when it was placed in the Fraunhofer diffraction pattern. More energy was absorbed when a shorter wavelength was employed. It was found that the model aerial became more efficient as it was moved away from the centre of the diffraction pattern. The direction of maximum sensitivity shifted as a function of the position of the model aerial in the diffraction pattern. Markedly different directional sensitivity patterns were obtained for different physical distributions, for different positions in those distributions, and for different wavelengths. There was essentially no interaction between two neighbouring receptors if their axes were kept parallel. Interaction did occur if the tapering sides were brought into contact or near contact. The implications of these findings are discussed.

612.843.31

5284. LUMINOSITY AND CHROMATICITY IN THE MESOPIC RANGE. R.Grigorovici and I.Aricescu-Savopol.
J. Opt. Soc. Amer., Vol. 48, No. 12, 891-8 (Dec., 1958).

The results of colorimetric measurements in the mesopic range require the division of this range into two parts; an upper mesopic range, in which only modifications of the colour mixture functions occur and in which the error of the green-blue ratio measurement increases with the reduction of the luminance of the colourmetric field; and a lower mesopic range, in which the vision becomes dichromatic, the green-blue ratio being entirely uncertain. A quantitative connection between the modifications undergone by the colour mixture functions and those undergone by the relative luminous efficiency function as a consequence of the reduction of the luminance of the visual field is proposed and checked by the good agreement with the experimental results. The dichromatic chromaticity coordinates of the spectrum colours in the lower mesopic range were calculated and found in good agreement with the experimental dichromatic chromaticity coordinates of Willmer and Wright valid for the dichromatic vision at very reduced extents of the visual field. Preliminary results in the range of excessive luminances are briefly reported.

612.843.613

5285. ABSOLUTE THRESHOLD FOR EXTREMELY WIDE FIELDS. S.M.Luria.
J. Opt. Soc. Amer., Vol. 48, No. 12, 884-6 (Dec., 1958).

The absolute visual threshold for an area 40° by 100° visual angle at a colour temperature of 2050°K was obtained for seven observers. Two conditions were used, (1) turning the light on and (2) turning the light both on and off before a judgment was made. The average threshold for the six observers in the 24-36 year age range was 2.35 log μμL. No difference in threshold was found between the two conditions. High rank order correlations were found between threshold (μμL) and size of the dark adapted pupil and between threshold (trolands) and age.

612.843.613

5286. "SHUTOFF PULSE ILLUSION". R.L.Ives.
Science, Vol. 129, 272 (Jan. 30, 1959).

Visual signals produced by sharp illumination decrements are commonly misinterpreted because of the presence of an illusory sharp increment at the moment of switching. Conditions for occurrence of the illusion are outlined, as well as conditions under which it is not reported.

612.843.615

5287. GLARE FROM SINGLE LIGHT SOURCES IN THE FIELD OF VIEW. W.Arndt, H.W.Bodmann and E.Muck.
Lichttechnik, Vol. 11, No. 1, 22-8 (Jan., 1959). In German.

Describes an investigation, with 240 observers, of the influence of various factors on the degree of discomfort produced by a single rectangular source of light in the field of view of an observer seated at a desk in a room of ordinary size. Results obtained, in the main, confirm previous investigations and the glare formula deduced is $G = B.\omega^{m}/P.B_u^{n}$ where B and B_u are luminances of the glare source and background, respectively, ω is the angular size of the source, and P is a function of its position in the field of view; $m = 0.34$ and $n = 0.64$. J.W.T.Walsh

614.898 : 539.12

NEUTRON ATTENUATION IN CONCRETE. See Abstr. 4918

TECHNIQUE . MATERIALS

620.179.1 : 535.371

NEW TECHNIQUES IN LOW LEVEL FLUOROSCOPY. See Abstr. 4466

669 : 535.825

RAPID-QUENCHING HOT STAGE FOR METALLOGRAPHY. See Abstr. 4505

669 : 535.825

MICROSCOPE ATTACHMENT FOR ACCURATE MICRO-DRILLING AND THE REMOVAL OF ANALYTICAL SAMPLES FROM SMALL AREAS. See Abstr. 4504

PHOTOGRAPHY

77.023 : 535.33

5288. REINFORCEMENT OF SPECTRAL LINES OBTAINED BY CONTACT FROM NEGATIVES MADE RADIOACTIVE.
G.Bastin-Scoffier.
J. Rech. Cent. Nat. Rech. Sci., No. 36, 301-2 (Sept., 1956).
In French.

A method is described for reinforcing faint lines on a photographic plate by making use of the affinity of Polonium for silver. After developing in the usual way the plates were soaked for some hours in a solution containing polonium. When dry the contrast was further increased by rubbing the surface with cotton wool soaked in alcohol to remove surface grains. Further reinforcement by exposure to mercury vapour is possible. Negatives are then made by contact with the plates for 24 to 48 hr. Examples are given of α lines from Th C in E_1 and C_2 emulsions. A.Ashmore

771.531

5289. EFFECT OF DESENSITIZERS ON THE REGRESSION OF THE LATENT IMAGE. H.Sauvenier.
Bull. Soc. Roy. Sci. Liege, Vol. 27, No. 9-10, 221-5 (Sept.-Oct.,1958).
In French.

If a photographic emulsion which has been uniformly exposed is desensitized, it gives a positive image if again exposed. The strength of the reversal depends on the wavelength, while the spectral distribution depends on the desensitizer used. The author describes the results of his experiments with two desensitizers and discusses the theory of the effect. J.W.T.Walsh

771.531 : 535.375.5 : 535.343

5290. NEW SPECIAL PLATES FROM THE FILM FACTORY AGFA WOLFEN FOR RAMAN SPECTROSCOPY. H.Mohr.
Exper. Tech. der Phys., Vol. 1, No. 4-5, 201-5 (Nov.-Dec., 1953).
In German.

Panchromatic and orthochromic Raman plates were made with a sensitivity 6 times that of plates used up to now, with the same graininess of the emulsion. C.Turne

778.33 : 535.822.1 : 537.53

A CRITICAL COMPARISON OF PROJECTION MICRORADIOGRAPHY AND THE 2X METHOD. See Abstr. 4663

778.3

5291. ON THE THEORY OF THE LATENT IMAGE PRODUCED BY CHARGED PARTICLES, THE EFFECT OF FLUCTUATIONS IN THE SPECIFIC LOSS OF ENERGY, AND GRAIN DENSITY IN THE NEIGHBOURHOOD OF THE IONIZATION MINIMUM.
M.C. Le Gentil and M.Morand.
C.R. Acad. Sci. (Paris), Vol. 247, No. 9, 741-4 (Sept. 1, 1958).
In French.

Mitchell's theory is considered and the minimum number of positive holes required to render a AgBr crystal developable is calculated to be 21 by one method and 50 by another. E.J.Burge

778.34

5292. EXPERIMENTS ON PROCESSING AND MOUNTING OF NUCLEAR EMULSIONS. B.Judek.
Canad. J. Phys., Vol. 37, No. 2, 102-8 (Feb., 1959).

A mounting procedure for Ilford G5, 600 μ stripped emulsions which gave very good results on several large and small stacks, totalling about 10 litres of emulsion, is described. Special tests have shown that emulsions can be developed almost immediately after mounting. Delay of processing for a day or longer after mounting offers no special advantage, while it causes fading of the latent image to an extent of about 15%. Experiments on development with a "warm" stage of 50° F indicate a reduction of spurious scattering to about one-half the value usually obtained with a "warm" stage of about 76° F. At the same time the degree of development obtained was comparable with that at 76° F. A better uniformity of development with depth in the emulsion has been obtained by a variation in the usual development procedure.

LIST OF JOURNALS

The following list supplements the List of Journals published with the Index to Volume 61 (1958). Reprints of the List of Journals can be obtained from The Institution of Electrical Engineers, Savoy Place, London, W.C.2, price 2s.0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

Conti Elektro Ber.	Conti Elektro Berichte. Formerly: C.E.I.G. Berichte. Continental-Elektroindustrie-Gesellschaft (CONTI-ELEKTRO), Jacobistrasse 3, Düsseldorf.
Semiconductor Prod.	Semiconductor Products. Cowan Publishing Corporation, 330 West 43rd Street, New York 36, N.Y.
Tekn. Forum	Teknisk Forum. Formerly: Tekniska Föreningens i Finland Förhandlingar. Tekniska Föreningens i Finland, Svenska Teaterhuset, Helsinki.

NEW JOURNAL

Lucas tech. Rev.	Lucas Technical Review. Joseph Lucas, Birmingham 15. No. 1 dated Nov., 1958.

NOTES

Electronica	Electronica. Address changed to: Roemer Visscherstraat 2-4-6, Amsterdam.
C.E.I.G. Ber.	C.E.I.G. Berichte. Title changed to: Conti Elektro Berichte [Conti Elektro Ber.], starting with Vol. 5, No. 1, January-March, 1959.
Tekn. Foren. Finland Forhandl.	Tekniska Föreningens i Finland Förhandlingar. Title changed to: Teknisk Forum [Tekn. Forum], starting with Vol. 79, No. 1, 1959.

The publication address of the following journals:

- Archiv für Elektrotechnik
- Naturwissenschaften
- Nukleonik
- Zeitschrift für angewandte Physik
- Zeitschrift für Physik
- Zeitschrift für Astrophysik

is now as follows: Springer-Verlag, Heidelberger Platz 3, Berlin-Wilmersdorf (West Berlin).

ERRATA

Abstr. 2578 (1959) line 3 : for "Vol. 145" read "Vol. 45".
Abstr. 4298 (1959) line 8 : for "composition" read "superposition".

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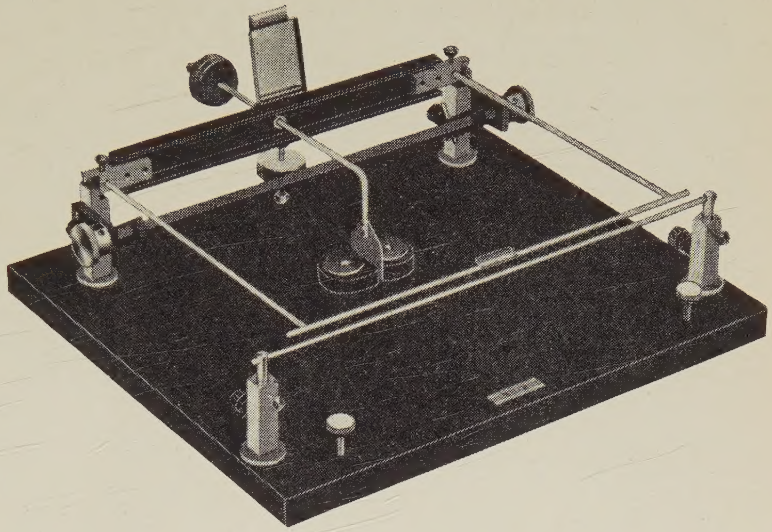

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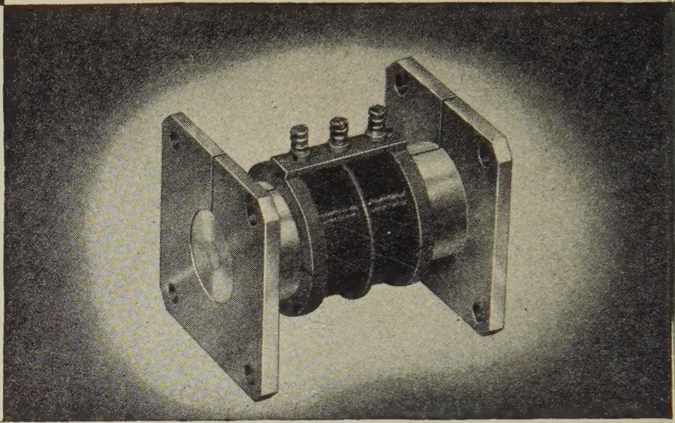

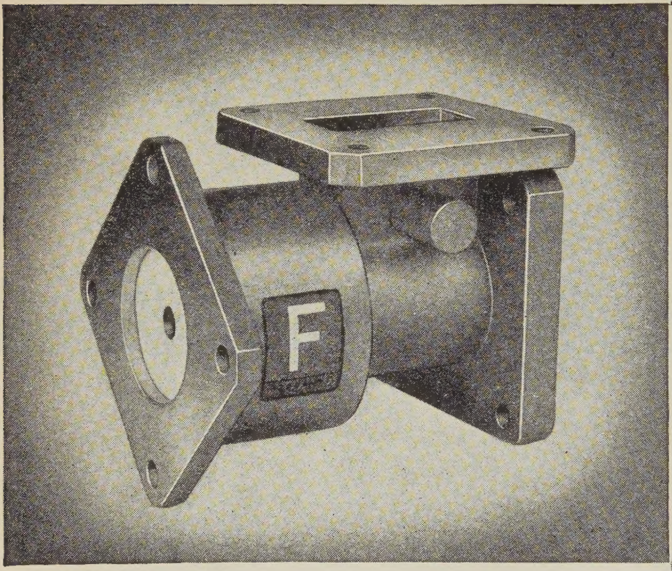

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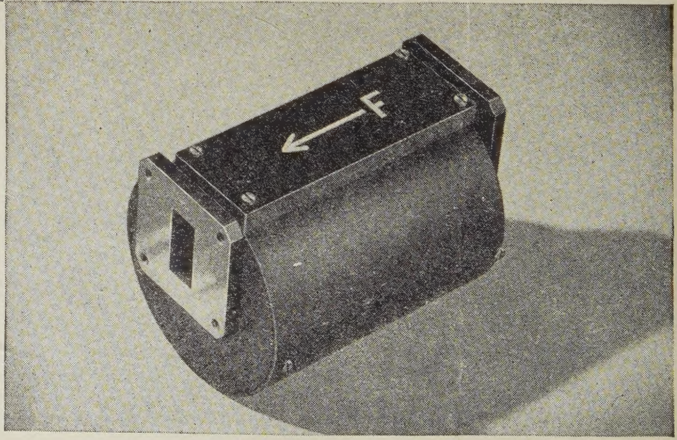

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